

101.11.5-4120-222-14

RETURN TO GOV. DEPT. OF THE ARMY

# TM 5-4120-222-14

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

**OPERATOR, ORGANIZATIONAL, DS, AND  
GS MAINTENANCE MANUAL  
AIR CONDITIONER: COMPACT,  
VERTICAL**

**208V, 3 PHASE: 18,000 BTUH COOLING  
12,000 BTUH HEATING (TRANE MODELS)**

**50/60 HERTZ MODEL CE20VAL6**

**FSN 4120-973-4589**

**400 HERTZ MODEL CE20VAL4**

**FSN 4120-858-5795**

This copy is a reprint which includes current  
pages from Changes 1 through 4.



HEADQUARTERS, DEPARTMENT OF THE ARMY

NOVEMBER 1969

## **WARNING**

### **GAS UNDER PRESSURE**

is used in the operation of this equipment.

### **DEATH**

or serious injury may result if personnel fail to observe the following  
safety precautions.

Do not perform maintenance on components when power is applied to the equipment.

Avoid bodily contact with liquid refrigerant and avoid inhaling refrigerant gas.

Be careful that Refrigerant-22 does not come in contact with eyes. If leak occurs, ventilate the  
area immediately.

CHANGE }

No. 1 }

HEADQUARTERS .  
DEPARTMENT OF THE ARMY  
Washington, D.C., 6 May 1971

**Operator, Organizational, DS and GS  
Maintenance Manual**  
**AIR CONDITIONER: COMPACT, VERTICAL, 208 V, 3 PHASE:**  
**18,000 BTUH COOLING, 12,000 BTUH HEATING (TRANE MODELS)**  
**50/60 HERTZ MODEL CE20VAL6, FSN 4120-973-4589**  
**400 HERTZ MODEL CE20VAL4, FSN 4120-858-5795**

TM 5-4120-222-14, 21 November 1969, is changed as follows:

Page 53, paragraph 5-33d. Note is superseded as follows:

**NOTE**

To install charge hoses, remove condenser fan and outside air thermostat. Insert hoses through the thermostat hole. Attach hoses to service valves. Install fan prior to operation. Capacity of refrigeration system is 3.7 pounds refrigerant-22, FSN 6830-174-9677.

Page A-1, paragraph A-2. TM 38-750 is changed to read:

TM 38-750            The Army Maintenance Management System

Page B-1. In Section II delete all columns of the following items:

Item 1. BINDER, Looseleaf

Item 4. ATTENUATOR

Item 5. BLOCKOFF PANEL

Item 6. RECEPTACLE, Electrical

By Order of the Secretary of the Army:

Official:

W. C. WESTMORELAND,  
General, United States Army  
Chief of Staff.

VERNE L. BOWERS,  
Major General, United States Army,  
The Adjutant General.

**Distribution:**

To be distributed in accordance with DA Form 12-25, (qty rqr block No. 542) Section III, Organizational Maintenance requirements for Air Conditioners, 18,000 BTU Compact.

CHANGE

No. 2

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C. 22 May 1972

# Operator, Organizational, Direct Support, and General Support Maintenance Manual

**AIR CONDITIONER, COMPACT, VERTICAL; 280V, 3 PHASE,  
18,000 BTU COOLING, 12,000 BTUH HEATING (TRANE MODELS)  
50/60 HERTZ, MODEL CE20VAL6, FSN 4120-973-4589;  
400 HERTZ, MODEL CE20VAL4, FSN 4120-858-5795**

TM 5-4120-222-14, 21 November 1969, is changed as follows:

Page B1. Appendix B is superseded as follows:

## APPENDIX B—BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED

### Section I. INTRODUCTION

#### B-1. Scope

This appendix lists items required by the operator for operation of the air conditioner.

#### B-2. General

This list is divided into the following sections:

*a. Basic Issue Items List—Section II.* Not applicable.

*b. Items Troop Installed or Authorized List—Section III.* A list of items in alphabetical sequence which, at the discretion of the unit commander, may accompany the air conditioner. These items are not subject to turn-in with the air conditioner when evacuated.

#### B-3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Items Troop Installed or Authorized, Section III.

*a. Source, Maintenance, and Recoverability Code(s) (SMR).*

(1) *Source code.* This code indicates the source for the listed item. Source codes are:

Code	Explanation
P	Repair parts, special tools, and test equipment supplied from GSA/DSA or Army supply system and authorized for use at indicated maintenance levels.
P2	Repair parts, special tools, and test equipment which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.

(2) *Maintenance code.* This code indicates the lowest level of maintenance authorized to install the listed item. The maintenance level codes is:

Code	Explanation
C	Crew/Operator

(3) *Recoverability code.* This code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are non-recoverable. Recoverability codes are:

Code	Explanation
R	Applied to repair parts (assemblies and components), special tools, and test equipment which are considered economically repairable at direct support and general support maintenance levels.
S	Repair parts, special tools, test equipment, and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis.

*b. Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description.* This column indicates the Federal item name and any additional description of the item required.

*d. Unit of Measure (U/M).* A 2-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based; e.g., ft, ea, pr; etc.

*e. Quantity Authorized.* This column indicates the quantity of the item authorized to be used with the equipment.



### Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR code	(2) Federal stock number	(3) Ref No. & mfr code	(4) Description	(5) Unit of meas	(6) Qty auth
PC	7520-559-9618		CASE, maintenance and operation manuals.	ea	1

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS,  
Major General, United States Army,  
The Adjutant General.

W. C. WESTMORELAND,  
General, United States Army,  
Chief of Staff.

Distribution:

To be distributed in accordance with DA Form 12-25C (qty rqr block No. 542), Organizational Maintenance Requirements for Air Conditioners: 18,000 BTU Compact.

CHANGE }  
No. 3 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC, 13 March 1975

**Operator's, Organizational, Direct Support,  
and General Support Maintenance Manual**

**AIR CONDITIONER: COMPACT, VERTICAL, 208, 3 PHASE,  
18,000 BTUH COOLING, 12,000 BTUH HEATING, (TRANE MODELS)  
50/60 HERTZ, MODEL CE20VAL6, NSN 4120-00-973-4589,  
400 HERTZ, MODEL CE20VAL4, NSN 4120-00-858-5795**

TM 5-4120-222-14, 21 November 1969, is changed as follows:

Title is changed as shown above.

*Page 2 of cover.* Add the following warning:

**WARNING**

The burning of polyurethane foams is dangerous. Due to the chemical composition of a polyurethane foam, toxic fumes are released when it is burned or heated. If it is burned or heated indoors, such as during a welding operation in its proximity, precautions should be taken to adequately ventilate the area. An exhaust system equivalent to that of a paint spray booth should be used. Air supplied respirators, approved by the National Institute for Occupational Safety and Health or the US Bureau of Mines, should be used for all welding in confined spaces and when ventilation is inadequate. Individuals who have chronic or recurrent respiratory conditions, including allergies and asthma, should not be employed in this type of environment.

By Order of the Secretary of the Army:

Official:

FRED C. WEYAND  
*General, United States Army  
Chief of Staff*

VERNE L. BOWERS  
*Major General, United States Army  
The Adjutant General*

**Distribution:**

To be distributed in accordance with DA Form 12-25C (qty rqr block No. 541), operator maintenance requirements for environmental equipment: air conditioners, 18,000 BTU, compact.



CHANGE

NO. 4

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D, C, 24 February 1978Operator's, Organizational, Direct Support,  
and General Support Maintenance Manual

**AIR CONDITIONER: COMPACT, VERTICAL, 208, 3 PHASE,  
18,000 BTUH COOLING, 12,000 BTUH HEATING, (TRANE MODELS)  
50/60 HERTZ, MODEL CE20VAL6, NSN 4120-00-973-4589,  
400 HERTZ, MODEL CE20VAL4, NSN 4120-00-858-5795**

TM 5-4120-222-14, 21 November 1969, is changed as follows:

APPENDIX C, Section II. MAINTENANCE ALLOCATION CHART is superseded as follows:

## Section II. MAINTENANCE ALLOCATION CHART

## AIR CONDITIONER TRANE MODEL CE20VAL4 AND MODEL CE20VAL6

(1) Group No.	(2) Assembly group	(3) Maintenance Functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	FRAME													
	Base assembly.....	F							F					
	Casing assembly.....	F							F					
	Guard, condenser fan.....	O							O					
	Screen, drain.....	O							O					
02	PANELS													
	Baffle.....	F							F					
	Chain and damper control.....	O							O					
	Cover assemblies.....	O							O					
	Damper assembly.....	F							F					
	Grilles.....	O							O					
	Insulation.....	F							F					
	Sound attenuator.....	O							O					
03	ACCESSORY ITEMS													
	Remote control.....	O							O					
04	ELECTRIC MOTOR													
	Motor assembly, blower.....		F						O	F				
	Rotor, blower motor.....	F							F					
	Stator, blower motor.....	F							F					
	Cover, stator housing.....	F							F					
	Endbell, housing.....	F							F					
	Housing, stator.....	F							F					
	Bearings.....	F							F					
														If required

AIR CONDITIONER TRANE MODEL CE20VAL4 AND MODEL CE20VAL6—Continued

(1) Group No.	(2) Assembly group	(3) Maintenance Functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
05	STARTING AND PROTECTING DEVICES.													
	Overload protector.....		F						F					
	Fuse.....		C						C					
	Phase relay.....		F						F					
	Control box.....	F							F					
	Connector, receptacle.....	F							F					
	Control panel assembly.....								F	F				
	Electrical leads.....	O							O					
	Receptacle.....	F							F					
	Circuit breaker.....		F						F					
	Switch, pressure.....		F						F					
	Thermostats.....		F						F					
06	ELECTRICAL EQUIPMENT													
	Heater elements.....	F							F					
	Rectifier.....		F						F					
07	GAGES													
	Sight glass.....	O							F					
08	REFRIGERATION AND AIR CONDITIONING COMPONENTS.													
	Compressor assembly.....		F	F					F					A
	Tubing and fittings.....	F	F						F					
	Valve, regulating.....				F				F					
	Valve, service.....								F					
	Valve, pressure relief.....								F					
	Valves, solenoid.....		F						F	F				B
	Condenser assembly.....			C					F	F				
	Dehydrator.....								F					
	Evaporator assembly.....	O		C					F	F				C
	Mist eliminator.....			C					O					
	Expansion valve.....				F				F					
	Fan assemblies.....								O					
	Air filters.....			C					O					D

By Order of the Secretary of the Army:

**BERNARD W. ROGERS**  
*General, United States Army*  
*Chief of Staff*

Official:

**J. C. PENNINGTON**  
*Brigadier General, United States Army*  
*The Adjutant General*

**Distribution:**

To be distributed in accordance with DA Form 12-25C, Operator maintenance requirements for Environmental Equipment: Air Conditioners, 18,000 BTU, Compact.



TECHNICAL MANUAL

No. 5-4120-222-14

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 21 November 1969

OPERATOR, ORGANIZATIONAL, DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

**AIR CONDITIONER: COMPACT, VERTICAL; 208 V, 3 PHASE; 18,000 BTUH COOLING,  
12,000 BTUH HEATING (TRANE MODELS) 50/60 HERTZ MODEL CE20VAL6  
FSN 4120-973-4589; 400 HERTZ MODEL CE20VAL4 FSN 4120-858-5795**

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\* This manual supersedes TM 5-4120-222-15, 18 July 1966.



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## INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope

a. This manual is published for the use of personnel to whom Military Models CE20VAL4 and CE20VAL6 air conditioners are issued. Information is provided on operation, preventive maintenance services, destruction, and organizational, direct and general support maintenance of equipment, accessories, components, and attachments. Also included are descriptions of main units and their relationship to other components.

b. Numbers in parentheses on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

#### 1-2. Forms and Records

a. DA Forms and procedures used for equipment maintenance will be only those prescribed by TM 38-750.

b. The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

### Section II. DESCRIPTION AND DATA

#### 1-3. Description

a. *General.* The air conditioner (figs. 1-1 and 1-2) is used primarily in van type enclosures for providing filtered, conditioned, or heated air as required to maintain service conditions necessary for the efficient operation of electronic equipment and for the comfort of operating personnel housed within the vans. It is a completely self-contained, air cooled, electric motor driven unit designed for continuous operation with varying loads. It is equipped with internal ducting to the low side of the evaporator fan so that ventilation air from the chemical and biological filter unit may be supplied by the evaporator fan.

b. *Condensing Section.* The condensing section, located at the bottom of the unit, contains the hermetically sealed compressors, condensing coil, condenser air intake opening, condenser air discharge opening, control panel, control box, thermostatic switch, power receptacle connector, condenser fan, blower motor, dehydrator, suction and discharge valves, and solenoid valves.

c. *Evaporator Section.* The evaporator section, located in the top of the unit, contains an evapo-

rator coil, evaporator fan, air conditioning filter, intake and discharge grilles, evaporator coil drain pan, expansion valves, electrical heaters, sight glass, and a damper to regulate the amount of outdoor air entering the air conditioner.

#### 1-4. Identification and Tabulated Data

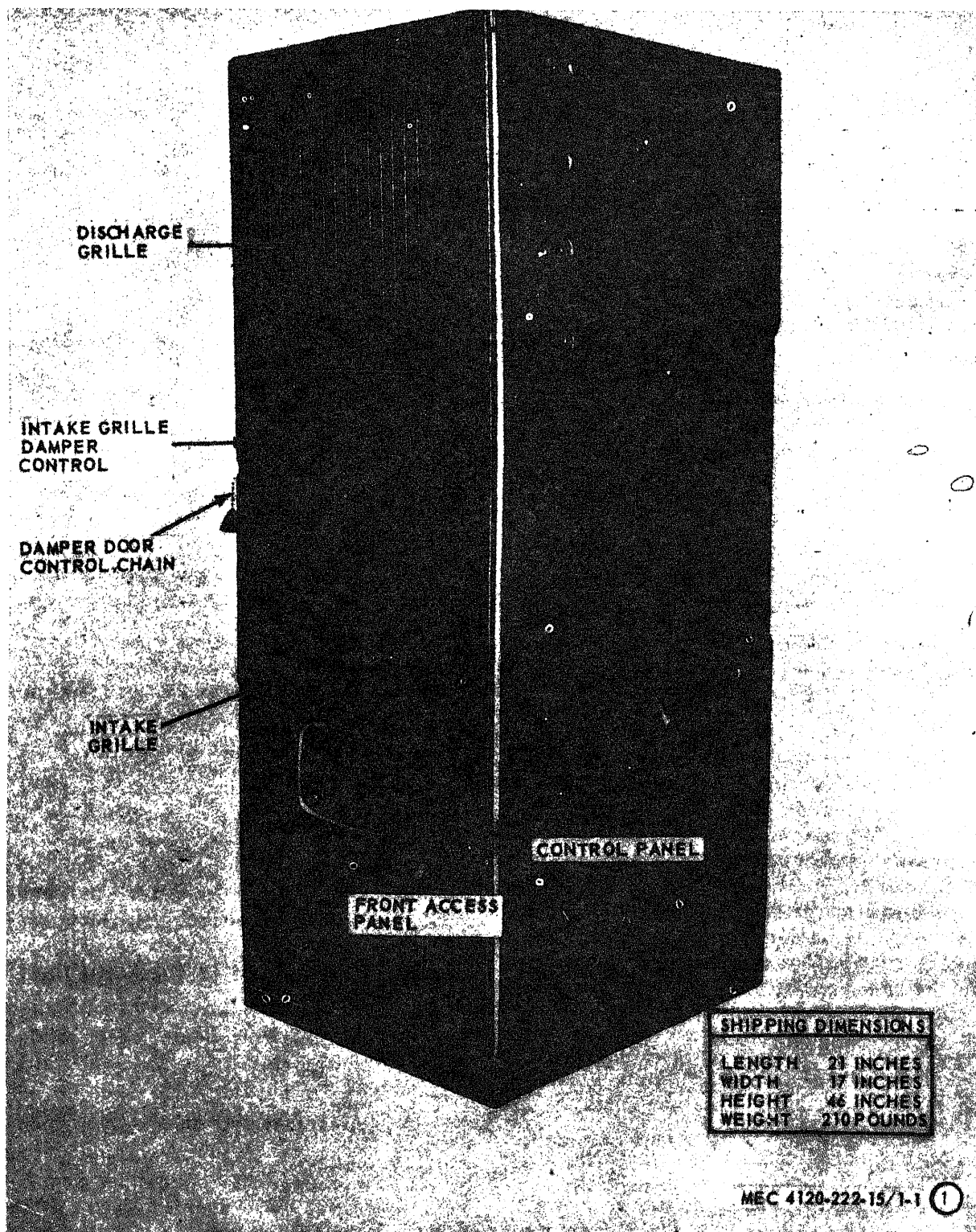
a. *Identification.* The air conditioners have eleven major identification and instruction plates. Information contained on these plates is listed below.

##### (1) Air conditioner (Model CE20VAL4)

(a) *Corps of Engineers plate A.* Located near top of back panel. Specifies nomenclature, manufacturer, model number, serial number, dimensions, weight and capacity.

(b) *Manufacturer's identification plate.* Located on rear panel just below sight glass. Specifies model number and serial number of the unit.

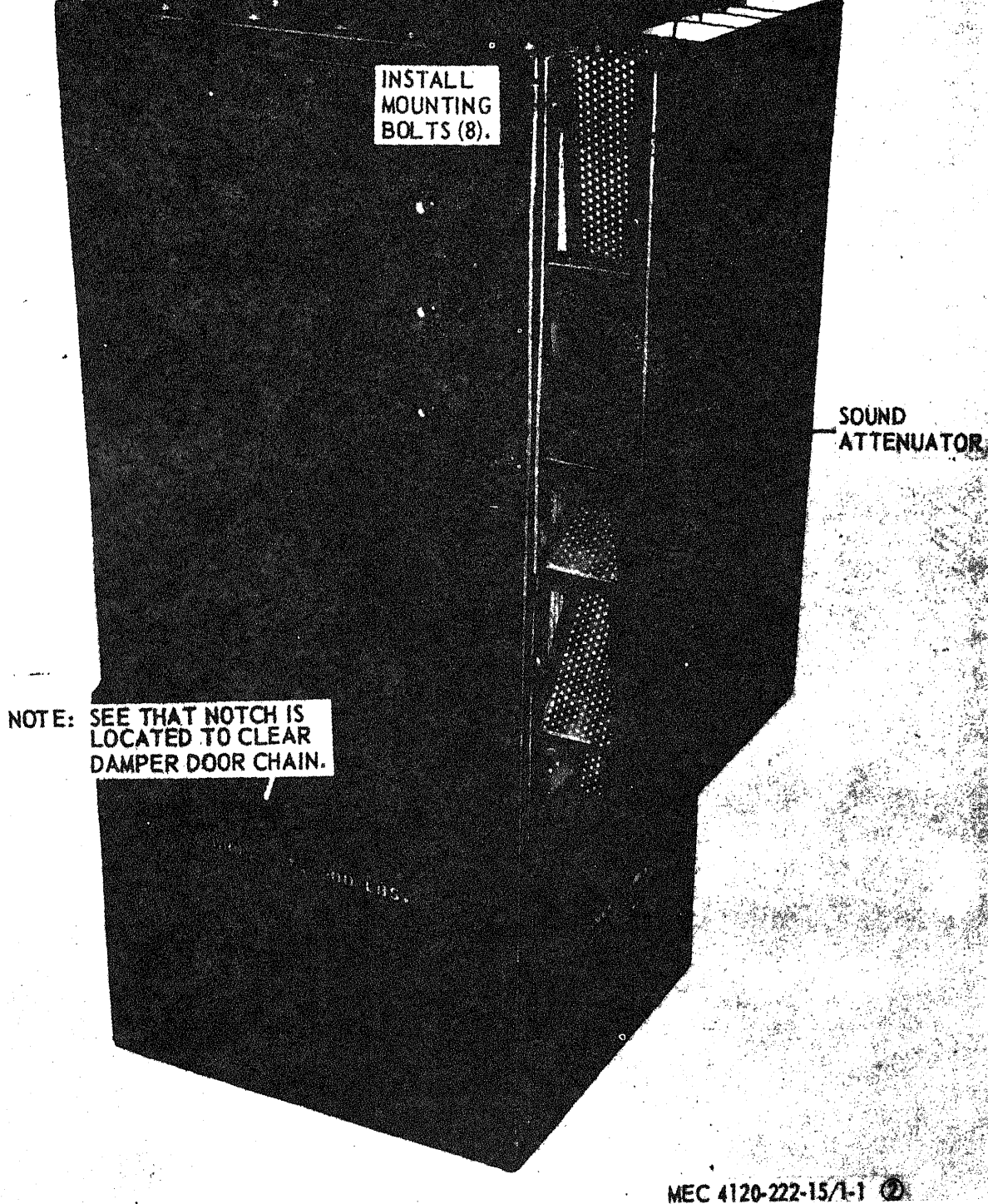
(c) *Compressor identification plates.* Located on front of compressor housing. Specifies compressor model number, part number, serial number, refrigerant, oil type and capacity, manufacturer, and complete electrical data.



① Left front three-quarter view, with shipping dimensions

*Figure 1-1①. Air conditioner, left front three-quarter view, with shipping dimensions. (Sheet 1 of 2)*

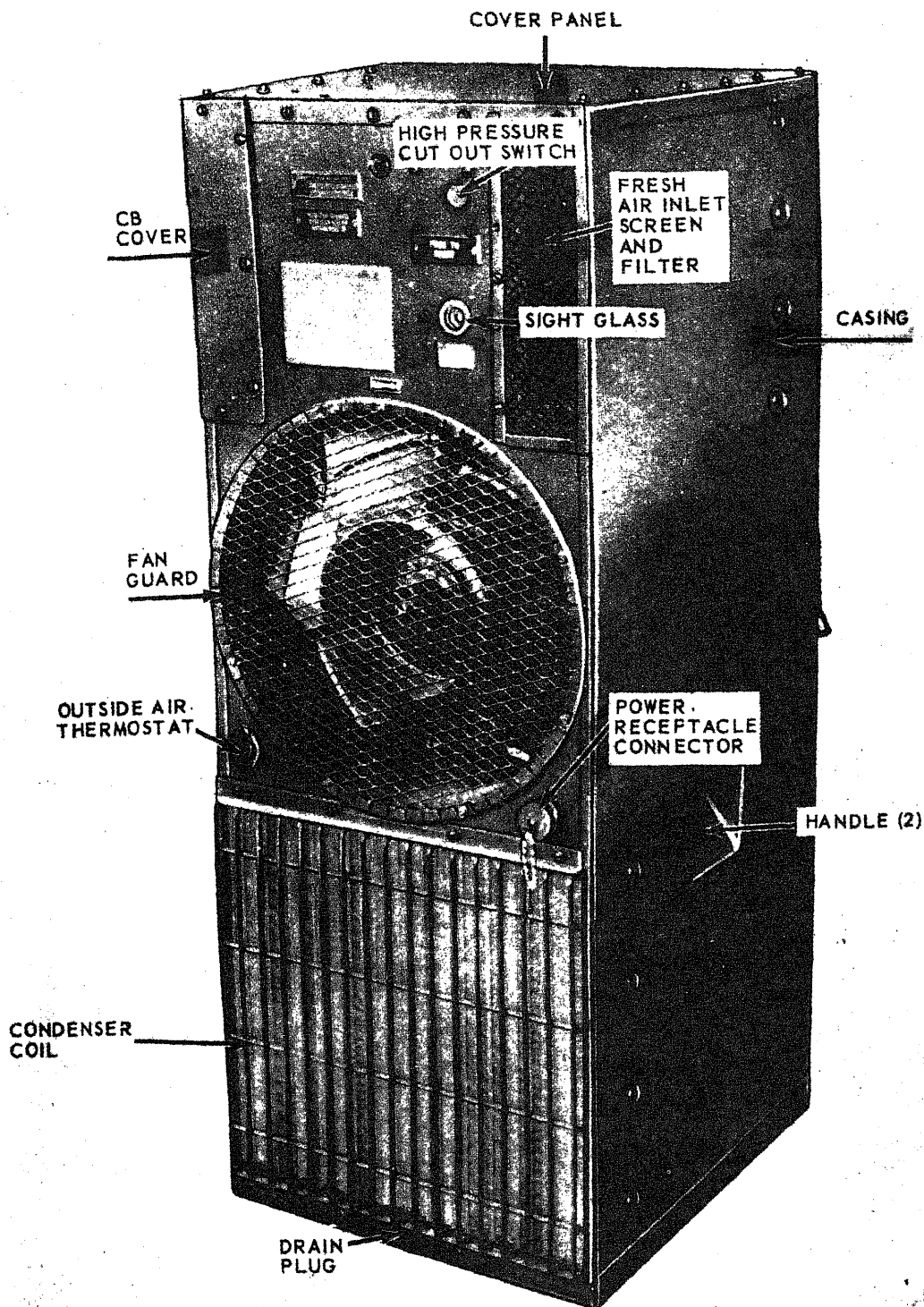
*Figure 1-1. Air conditioner.*



② Right front three-quarter view, with sound attenuator

*Figure 1-1* ②. Air conditioner, right front three-quarter view,  
with sound attenuator. (Sheet 2 of 2)

*Figure 1-1*—Continued.



MEC 4120-222-15/1-2

Figure 1-2. Air conditioner, right rear three-quarter view.

(a) *Corps of Engineers plate A.* Located above fan guard on back panel of unit. Specifies nomenclature, manufacturer, model number, serial number, dimensions, weight, and capacity.

(b) *Manufacturer's identification plate.* Located above fan guard on rear panel. Specifies model number and serial number of the unit.

(c) *Compressor identification plates.* Located on front of compressor housing and compressor crankcase. Specifies compressor model number, part number, serial number, refrigerant, manufacturer, and complete electrical data.

(3) *Identification applicable to both models.*

(a) *Blower motor identification.* Located on top of the blower motor. Specifies motor horsepower, type, serial number, rpm's (revolutions per minute), part number, order number and electrical characteristics.

(b) *Control panel legend plate.* Located on front of unit control panel. Indicates unit temperature setting for cooling or heating purposes.

(c) *Wiring diagram plate.* Located on inside of front access panel, illustrates complete unit wiring.

(d) *Refrigerant -22 plate.* Located on rear panel above condenser fan guard. It states that the unit is charged with 3.50 pounds of Refrigerant -22.

(e) *Color indicating plate.* Located on rear panel immediately below the refrigerant sight glass. It has three color bands: green, chartreuse, and yellow, which are used in conjunction with the liquid line sight glass to indicate moisture condition of dehydrator.

(f) *High pressure cutout control reset plate.* Located on rear panel just below high pressure cutout control reset button with nomenclature: PUSH TO RESET

(g) *Indicating arrow plate.* Located on rear panel just above condenser fan guard; arrow indicates direction of condenser fan rotation.

#### *b. Tabulated Data.*

(1) *Air conditioners (Model CE20VAL4)*

(a) *Corps of Engineers plate A.*

1. *Air Conditioner, Self Contained, Base Mtg, 208 VAC, 400 Hertz 3-Phase, Air Cooled.*

Stock No.....	FSN 4120-858-5795
Manufacturer.....	Trane
Model.....	CE 20 VAL4
Length.....	19 in. (inches)
Width.....	17 in.
Height.....	46 in.
Capacity.....	18,000 BTU/HR (British Thermal Units/Hour)
Shipping weight.....	210 lb (pounds)

Stock No.....	FSN 4120-973-4589
Manufacturer.....	The Trane Co.
Model.....	CE 20 VAL6
Length.....	19 in.
Width.....	17 in.
Height.....	46 in.
Capacity.....	18,000 BTU/HR
Shipping weight.....	200 lb (pounds)

(b) *Manufacturer's identification plate.*

Manufacturer..... The Trane Company

(c) *Evaporator and condenser fan motor*

#### *1. Procurement on Trane Model.*

Manufacturer.....	U.S. Electrical Motors, Inc.
HP (horse power).....	1.62
Type.....	Double extended shaft
Volts.....	208
Amps (amperes).....	0.8
Frame.....	7234
Frequency.....	400 hertz
Phase.....	3
Part No.....	405835
RPM.....	3800
Duty.....	Continuous
Drive.....	Direct

#### *2. Alternate.*

Manufacturer.....	Welco
HP.....	1.65
Type.....	Double extended shaft
Volts.....	208
Frequency.....	400 hertz
Phase.....	3
RPM.....	3700
Duty.....	Continuous
Drive.....	Direct
Part No.....	856008

(d) *Compressor.*

#### *1. Data on.*

Manufacturer.....	Whirlpool
Model.....	WHP422-H18-208-3
Part No.....	474843
Type.....	Rotary Vane
Lubrication.....	Slinger
Phase.....	3
RPM.....	3660
Frequency.....	400 hertz
Voltage.....	208
Lra (locked rotor amperage).....	64.0

#### *2. Data on.*

Manufacturer.....	Bendix-Westinghouse
Model.....	422H-18
Part No.....	2101C200065
Type.....	Hermetically sealed reciprocating
Lubrication.....	Forced feed
RPM.....	3750



Displacement.....	7.0 cfm (cubic feet per minute)
Phase.....	3
Frequency.....	400 hertz
Voltage.....	208
Fla (full load amperage).....	20.5
Lra.....	70.0

*(e) Performance data.*

Cooling Capacity.....	18,000 BTU/HR nominal, 19,800 BTU actual at 125°F. (Fahrenheit) DB (Dry Bulb), air to con- denser, 90°F. DB, return air to unit at 1.0 SHR (Sensible Heat Ratio) 12,000 BTU/HR (Hi-heat position) 6,000 BTU/HR (Lo-heat position).
-----------------------	---

*(f) Dimensions and weight (fig. 1-1).*

Length.....	21 in. (inches)
Width.....	17 in.
Height.....	46 in.
Weight (crated).....	210 lbs.

*(2) Air Conditioner (Model CE20VAL6)*

*(a) Corps of Engineers plate A. Air Condi-  
tioner, Self Contained, Base Mtg, 208 VAC, 50/60  
Hertz, 3-Phase, Air Cooled.*

Stock No.....	FSN 4120-973-4589
Manufacturer.....	Trane
Length.....	19 in.
Width.....	17 in.
Height.....	46 in.
Capacity.....	18,000 BTU/HR
Shipping weight.....	200 lbs.

*Manufacturer's identification plate.*

Manufacturer.....	U.S. Electrical Motors, Inc.
Type.....	Double extended shaft
HP.....	1.42
Volts.....	208
Amps.....	4.1
Frame.....	7244
Frequency.....	50/60 hertz
Phase.....	3
Part No.....	405832
RPM.....	3450
Duty.....	Continuous
Drive.....	Direct
Electrical overload protection.....	Automatic reset thermal overload and overcurrent.
Connector.....	MS3102R14S-7P

*2. Alternate.*

Manufacturer.....	Welco
Type.....	Double extended shaft
HP.....	1.42
Volts.....	208
Frequency.....	50/60 hertz

Phase.....	3
Part No.....	856007
RPM.....	3450
Duty.....	Continuous
Drive.....	Direct
Overload Protection.....	Automatic reset thermal overload and overcurrent

*(d) Compressor.*

Manufacturer.....	Whirlpool
Model.....	WHP622-H18-208-3
Part No.....	474837
Type.....	Rotary Vane
Lubrication.....	Forced feed
RPM.....	3390
Phase.....	3
Frequency.....	50/60 hertz
Volts.....	208
Lra.....	67.0

*Data on.*

Manufacturer.....	Bendix-Westinghouse
Model.....	MYH700TA-3
Part No.....	42594K200003
Type.....	Hermetically sealed, reciprocating
Lubrication.....	Forced feed
RPM.....	3450
Displacement.....	6.5 cfm
Phase.....	3
Frequency.....	50/60 hertz
Volts.....	208
Fla.....	8.5
Lra.....	61

*(e) Performance Data.*

Cooling Capacity.....	18,000 BTU/HR nominal, 19,800 BTU/HR actual at 125 F. DB, air to condens 90°F. DB, return air to u at 1.0 SER.
Heating Capacity.....	12,000 BTU/HR (Hi-heat position) 6,000 BTU/HR. (Lo-heat position).

*(f) Dimensions and Weight.*

Length.....	21 in.
Width.....	17 in.
Height.....	46 in.
Weight (crated).....	223 lbs.

*c. Data Applicable to Models CE20VAL6 and  
CE20VAL4.*

*(1) Evaporator and condenser fans.*

Mfg.....	The Trane Company
Type.....	Condenser-propeller Evapo- rator-Centrifugal
No. per Unit.....	1 each
Rotation (facing condenser air discharge grille).....	Clockwise

*(2) Condenser and evaporator coils.*

Mfg.....	The Trane Company
Type.....	Brazed aluminum
No. Per Unit.....	1 each

### (3) Motor and heater contactors.

Mfg.-----Cutler-Hammer  
Part number-----9565ED3  
Amps-----25  
Type-----3 pole, single throw, N.O.  
Coil-----Pickup at 170VDC continuous  
operation at 230 VDC

Operating ambient temperature-----+65° to +125°F.

### (4) Thermostat control.

Mfg.-----Penn  
Type-----229XC  
Action-----Single pole double throw  
Range-----+40° to +90°F.  
Electrical rating-----120 VAC

### (5) Selector switch.

Mfg.-----Cutler-Hammer  
Type-----Rotary (manual)  
Part No.-----8912K216  
No. of positions-----5 (hi-heat, lo-heat, off,  
ventilate, cool)  
Electrical rating-----15 Amps, 250 VAC

### (6) Outside air thermostat.

Mfg.-----Stevens Mfg. Co. Inc.  
Type-----NPT25SPDT (single pole,  
double throw)  
Electrical rating-----208 VAC, pilot duty 20 VAC.  
Operation-----Contacts open on temperature  
decrease  
Range-----Contacts open 50° ±3°F.),  
differential 10 F. maximum

### (7) Heater thermostat.

Mfg.-----Metals and controls, Inc.  
Type-----Kilxon MWA1256 automatic  
reset  
Electrical rating-----208 V, 60 and 400 hertz, 3  
phase resistive load.  
Contacts open-----90°C. (Centigrade)  
Contacts close-----61°C.

### (8) Electric heaters.

Mfg.-----The Trane Company  
Type-----Stainless Steel Sheath  
Voltage-----120 VAC  
Watts-----600 each  
No. per unit-----6

### (9) Pressure relief valve.

Mfg.-----Superior  
Part No.-----3001X3  
Setting-----540 psi

### (10) Back pressure regulating valve.

Mfg.-----Controls Company of America  
Model-----104A  
Part No.-----70034-105  
Setting-----58 psi

### (11) Service valves (suction and discharge).

Rating-----600 psi  
No. per unit-----2

### (12) Solenoid valves.

No. per unit-----3 (1 liquid line, 1 hot gas  
bypass, 1 quench line)  
Watts-----10  
Voltage-----187 (DC)  
Refrigerant-----R-22

### (13) Thermo expansion valve (evaporator).

Mfg.-----Alco  
Model-----TCL50H  
Type-----Angle  
Inlet-----¼ in. OD  
Outlet-----¾ in. OD  
Setting-----10° superheat  
Capacity-----½ ton  
Superheat setting-----10°F.

### (14) Liquid line sight glass.

Mfg.-----Sporlan  
Type-----SAK13

### (15) High pressure cutout control.

Mfg.-----Penn  
Model-----210AP40  
Connection-----¼ in. SAE flare  
Cutout point-----445 ±10 psi  
Manual reset-----400 psig

### (16) Dehydrator.

Mfg.-----Sporlan  
Type-----C083S

### (17) Capacities.

Compressor crankcase-----Oil 3½ pts.  
Refrigerant charge-----3.50 lbs. (R-22)

### (18) Dimensions and weight.

Length-----21 in.  
Width-----17 in.  
Height-----46 in.  
Weight (crated)-----CE20VAL4 210 lbs.  
CE20VAL6 223 lbs.

(19) Base plan. Refer to figure 1-3 for the base plan.

(20) Wiring diagrams. Refer to figure 1-4 for the wiring diagram.



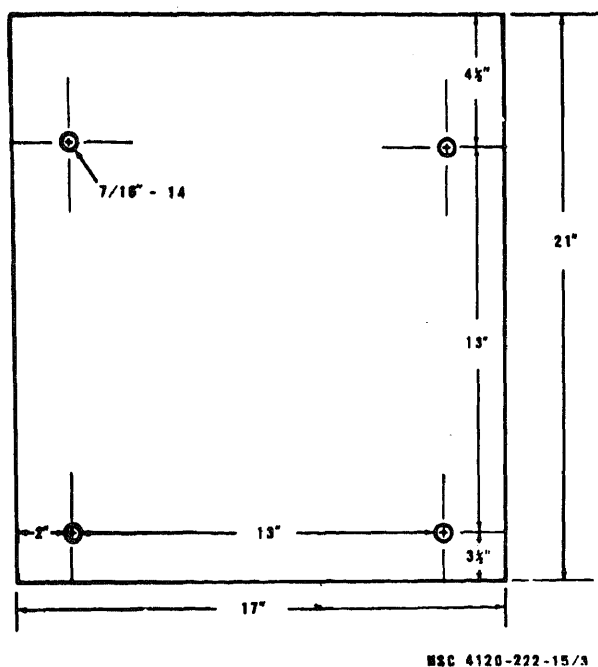


Figure 1-3. Base plan.

Figure 1-4(1). Practical wiring diagrams.

Located in back of manual

## 1-5. Difference in Models

a. This manual covers Models CE20VAL4 and CE20VAL6 Air Conditioners. Difference between the models are in the blower motors, compressors, and control circuits. Where differences exist, each model is covered separately in the applicable section of this manual. The CE20VAL4 air conditioner has a 400 hertz blower motor and compressor, while the CE20VAL6 has a 50/60 hertz blower motor and compressor. Both models may

be equipped with either a Bendix-Westinghouse or Whirlpool compressor. If the unit has a Whirlpool compressor, it will have a phase sequence relay. The Bendix-Westinghouse compressor has a crankcase heater and thermostat.

b. Model CE20VAL4 air conditioners in the following serial number range 259827 through 259944, 264148 through 264189, 280747 and 280748, 280754 through 280765, 292448 through 292452, 298409 and 298410, 298420 through 298480, 303133 through 303157, 308223, 308225 through 308232, 410653 through 410724, 413831 through 413867 have a surge suppressor, rectifier, and circuit breaker but have no high pressure cutout switch, fuses, or the new air foil evaporator and condenser fans. Model CE20VAL4 air conditioners in the following serial number range 450442 through 404510 have a solid state rectifier, two 5 amp fuses, high pressure cutout switch, air foil evaporator and condenser fans, Whirlpool compressor and Welco fan motor. They do not have a surge suppressor.

c. Model CE20VAL6 air conditioners in the following serial number range 283755 through 283764, 292428 through 292437, 292439 through 292445, 292447, 303326 through 303329, 303331 through 303337, 303341 and 303342, 315122 and 315124, 303344 have a surge suppressor and rectifier but have no fuses, circuit breaker, high pressure cut-out switch, solid state rectifier, or the new air foil evaporator and condenser fans. Model CE20VAL6 air conditioners in the following serial number range 432476 through 432485, 450516 through 450668, 481947 through 481962 have a solid state rectifier, two 5 amp fuses, circuit breaker, high pressure cutout switch, Welco fan motor, and the new air foil evaporator and condenser fan but have no surge suppressor. Not all units are equipped with a fresh air filter.

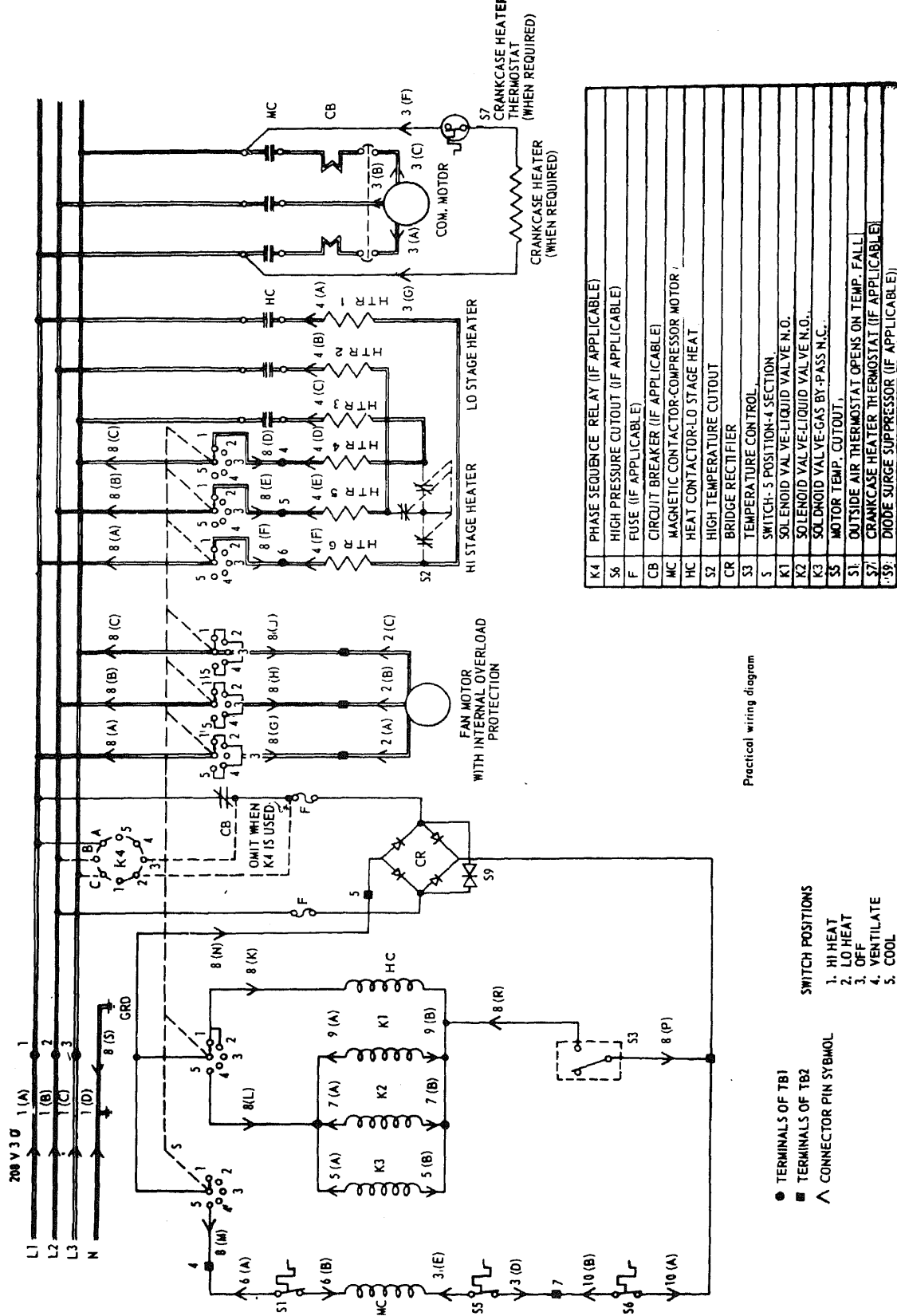


Figure 1-4(2). Practical wiring diagram. (Sheet 2 of 2)

## CHAPTER 2

### INSTALLATION AND OPERATING INSTRUCTIONS

#### Section I. SERVICE UPON RECEIPT OF EQUIPMENT

##### 2-1. Inspecting and Servicing Equipment

a. Perform daily preventive maintenance services (para 3-4).

b. Perform quarterly preventive maintenance service (para 3-4).

c. Inspect entire air conditioner for signs of damage, paying particular attention to evaporator and condenser coils.

d. The air conditioner contains a full operating charge of refrigerant and compressor oil. No further service is required.

##### 2-2. Installation of Separately Packed Components

a. *General.* The air conditioner is basically a self-contained unit, however, in certain installations it may become desirable to utilize the sound attenuator and/or the remote control blockoff plate with an electrical receptacle.

b. *Sound Attenuator.* The sound attenuator will provide a sound dampening effect and is mounted on the front of the air conditioner (fig. 1-1 (2)). The sound attenuator replaces the air intake and discharge grilles and air is taken in and discharged through the attenuator bases. Air is taken in through the bottom and discharged through the top of the attenuator. Refer to figure 1-1 (2), and install the sound attenuator as follows:

(1) Remove the intake and exhaust grilles (para. 3-17).

(2) Inspect the attenuator for breaks, cracks, or other damage.

(3) Place the sound attenuator in position on the front of the unit by aligning the grille mounting holes with the attenuator mounting holes.

*Note.* Make sure that the notched edge of the attenuator frame matches the damper door control chain location.

(4) Install the mounting bolts.

(5) Store the grilles so as to avoid possible damage.

c. *Blockoff Plate.* The blockoff plate is provided for installation when the controls are removed for remote control operation. The blockoff plate provided must be used so that no air will enter the lower compartment. Refer to figure 2-1, and install the blockoff plate.

##### 2-3. Installation or Setting-Up Instructions

a. *General.* Set air conditioner in a level position to allow proper condensate draining (operation will be satisfactory with unit setting at a slight angle, and using one of the alternate drain connections).

b. *Locating the Unit.* The front access panel and discharge and intake grilles are removable for normal service and maintenance, and must always be unobstructed to allow sufficient air for condensing purposes. The discharge and intake openings at front of unit should be relatively free from obstruction to permit maximum unit capacity.

*Note.* Remove discharge and intake grilles and filter, if unit is to be used with ducts carrying air to and from the conditioned space. Install grilles and filter in the duct.

*Note.* Remove intake cover (fig. 1-2) if a Chemical and Biological filter unit is to be attached to the unit.

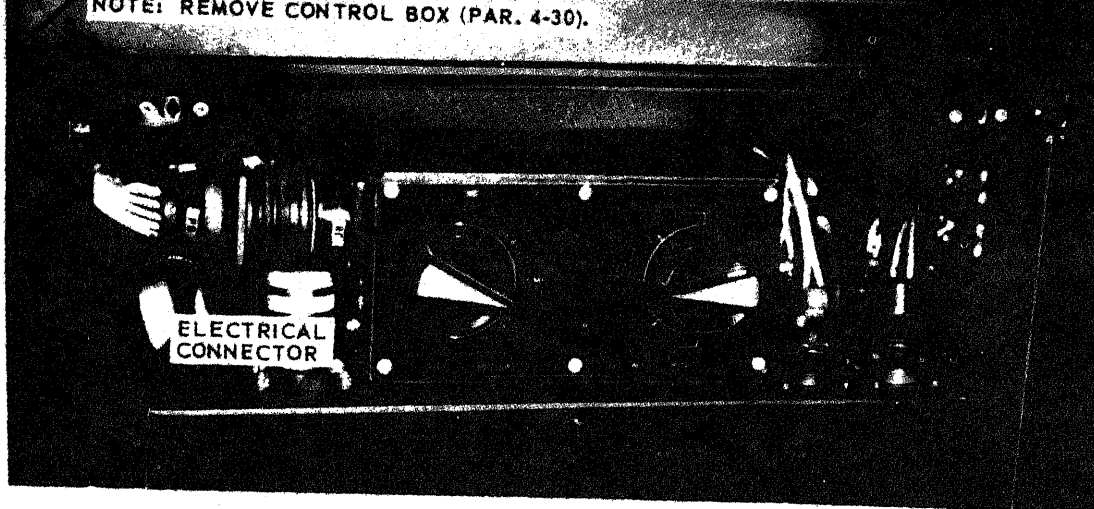
c. *Installing Unit.* Bolt unit to floor or other flat surface. Refer to base plan (fig. 1-3) for dimensions. Connect drain hose to drain nipple at bottom of unit to lead condensate away from unit. Alternate  $\frac{1}{2}$  NPT condensate drain connections are provided at both sides and front of unit. If one of these are used, insert a  $\frac{1}{2}$ -inch square head plug in the rear connection. Some units are provided with 4 drain plugs installed. Remove the desired drain plug prior to installing the drain hose.

d. *Power Source.*

(1) *Model CE20VAL4.* Operates on 208 volt, 400 hertz, 3 phase power.

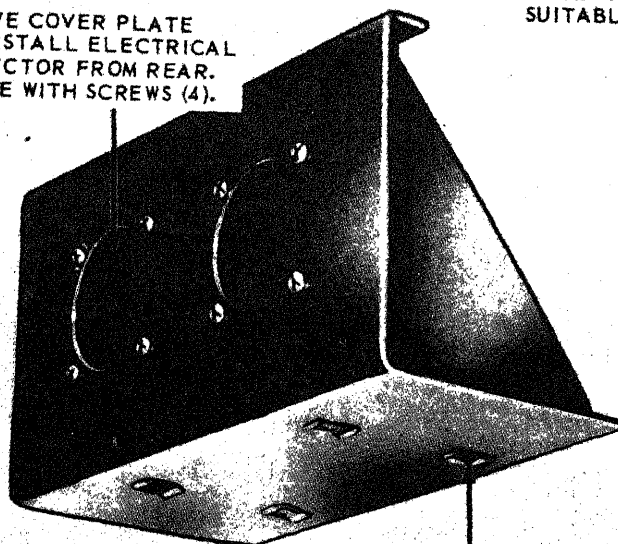
(2) *Model CE20VAL6.* Operates on 208 volt, 50/60 hertz, 3 phase power.

NOTE: REMOVE CONTROL BOX (PAR. 4-30).



A. CONTROL PANEL

REMOVE COVER PLATE  
AND INSTALL ELECTRICAL  
CONNECTOR FROM REAR.  
SECURE WITH SCREWS (4).



NOTE: CONNECT CONTROL  
PANEL AND BLOCKOFF  
RECEPTACLE WITH  
SUITABLE CABLE.

MATCH TO HOLES ON  
CONTROL BOX TOP PANEL  
AND INSTALL MOUNTING  
BOLT (4).

B. BLOCKOFF PANEL

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Figure 2-1. Remote control connection installation.

(3) *Power receptacle connector.* An MS3100R-22-22P receptacle is located at rear of unit above the condenser coil air inlet. Connect the proper electrical power supply source to this receptacle using a MS3106R-22-22S plug or receptacle alternate. Alternate electrical power connec-

tions are provided at both sides of the unit, any location may be used by interchanging the power receptacle at rear of unit and one of the cover plates at side of unit. Be sure to attach cover plate over unused location at rear of unit to prevent air from being drawn through the opening.

power supply connection, momentarily move the selector switch to ventilate. The air flow should be through the intake grille (see fig. 1-1(1)) and out the discharge grille. If the air flow is incorrect, interchange any two power leads. (See wiring diagram.)

*e. Remote control.*

(1) *General.* The control panel may be removed from the unit and used as a remote control for operation of the air conditioner. The remote

must be used when the control panel is used as a remote control.

(2) *Remote control connection.*

(a) Disconnect power source from unit.

(b) Refer to figure 2-1, and install remote control connection.

(3) *Inspection.* Inspect remote control panel for breaks, cracks, or other damage prior to installation.

## Section II. MOVEMENT TO NEW WORKSITE

### 2-4. Dismantling for Movement

*a. General.*

(1) Shut off electrical power supply to air conditioner and disconnect power cable from unit.

(2) Disconnect drain hose from unit.

*Note.* Disconnect all duct work and remote control cable if used with unit.

(3) Unbolt unit from mounting surface.

*b. Short distance movement.* Use a forklift and lift unit at base, or carry unit to new worksite using the recessed handles at sides of unit.

*c. Long distance movement.* Crate the air conditioner, providing adequate protection to grille and control panel. Refer to TM 38-230-1 for instruction in crate fabrication. Provide suitable blocking and tie-downs to prevent unit from shifting during transfer.

### 2-5. Reinstallation After Movement

Reinstall the air conditioner as instructed in paragraph 2-3.

## Section III. CONTROLS AND INSTRUMENTS

### 2-6. General

This section describes, locates, illustrates, and furnishes the operator, crew or organizational maintenance personnel sufficient information about the various controls and instruments for proper operation of the air conditioner.

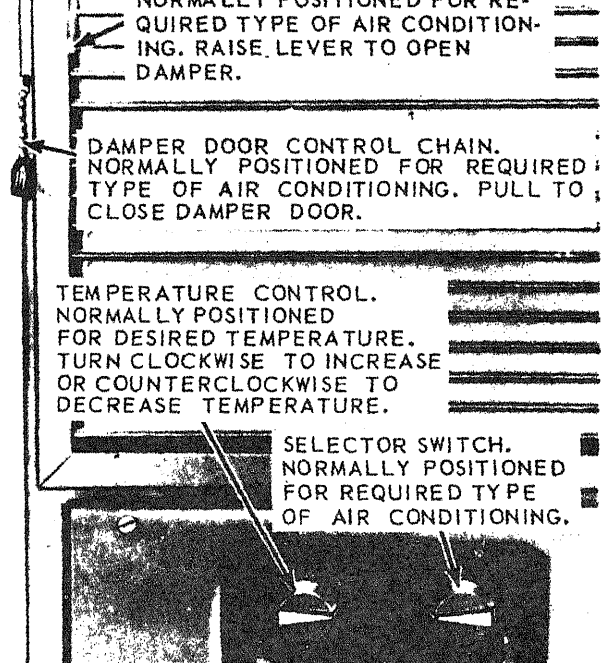
### 2-7. Controls and Instruments

*a.* The controls and instruments on the air conditioner are illustrated on figure 2-2.

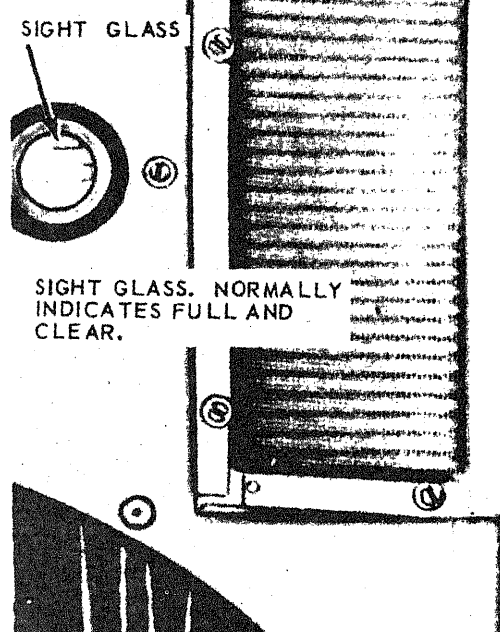
*b. High pressure cutout control.* The high pres-

sure cutout located at the rear of the unit (figure 2-15) is designed to sense line pressure from the compressor and will cutout at 445 psig (pounds per square inch gage). When the line pressure has been reduced to 400 psi, the high pressure cutout control can be reset by pushing the reset button.

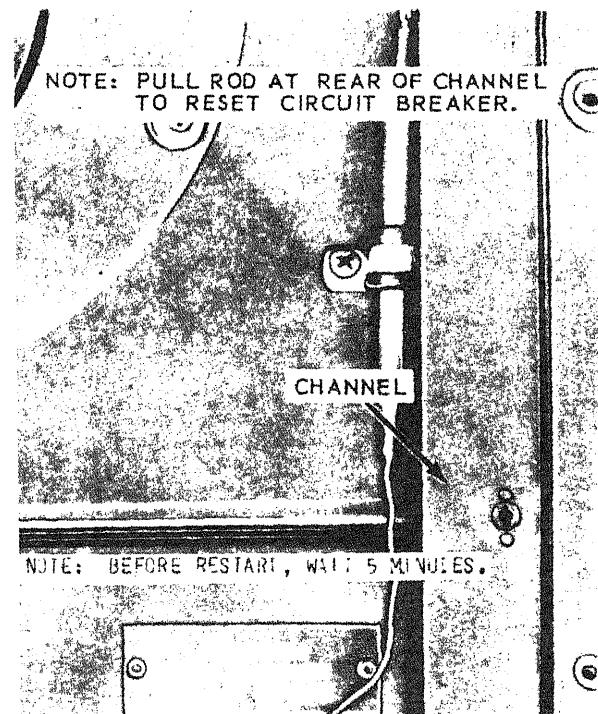
*c. Liquid line sight glass.* The sight glass (figure 2-2) indicates dryness of the system. Moisture in the refrigerant is shown by the indicator turning from green to yellow. A shortage of refrigerant is indicated by bubbles in the sight glass.



A. DAMPER CONTROLS, TEMPERATURE CONTROL AND SELECTOR SWITCH.



B. SIGHT GLASS.



C. CIRCUIT BREAKER

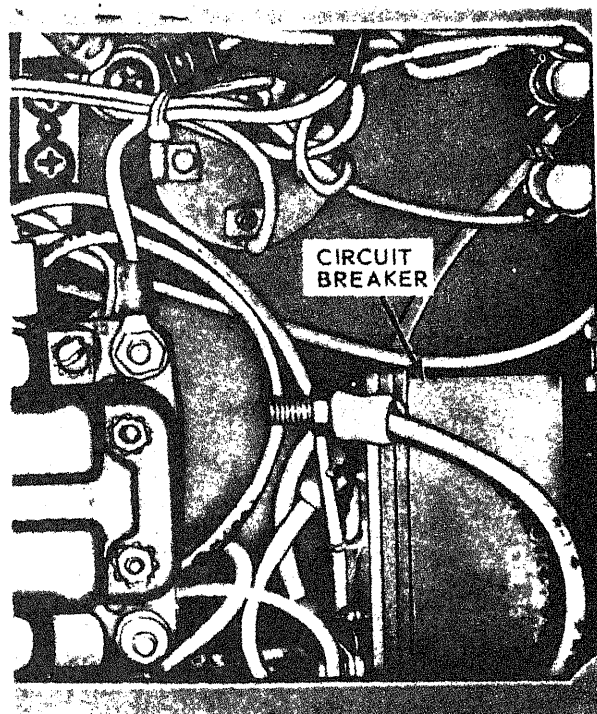
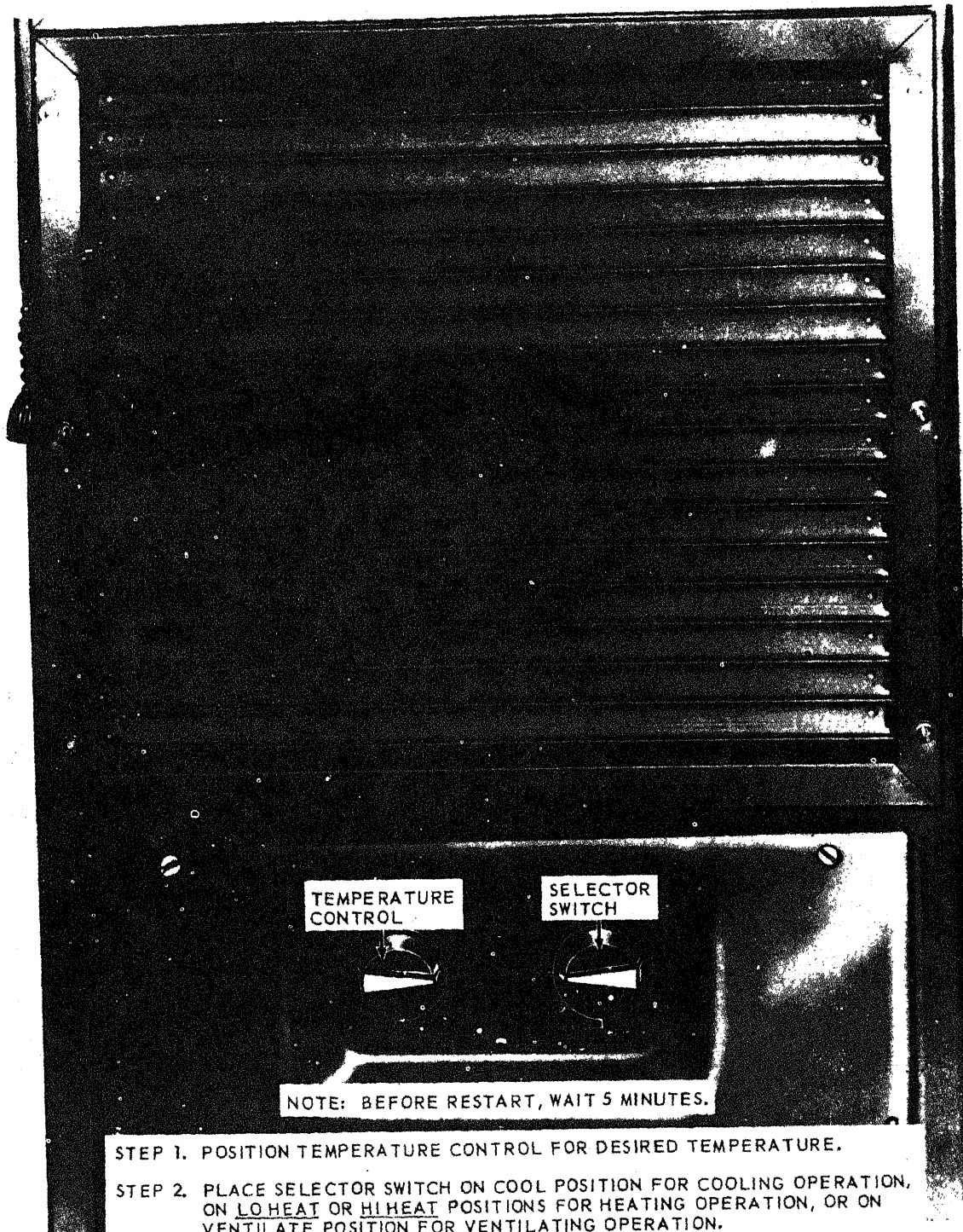


Figure 2-2. Controls and instruments.

## 2-8. General

a. The instructions in this section are published for the information and guidance of personnel responsible for the operation of the air conditioner.

b. The operator must know how to perform every operation of which the air conditioner is capable. This section gives instructions on starting, stopping, and operating details of the air conditioner. Since nearly every application pre-



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Figure 2-3. Starting instructions.

sents a different problem, the operator may have to vary given procedure to fit the individual job.

## 2-9. Starting

a. Perform the daily preventive maintenance checks and services (para 3-4).

b. Refer to figure 2-3, and start the air conditioner. If the unit fails to start, pull the circuit breaker reset rod behind air filter and push high press switch reset.

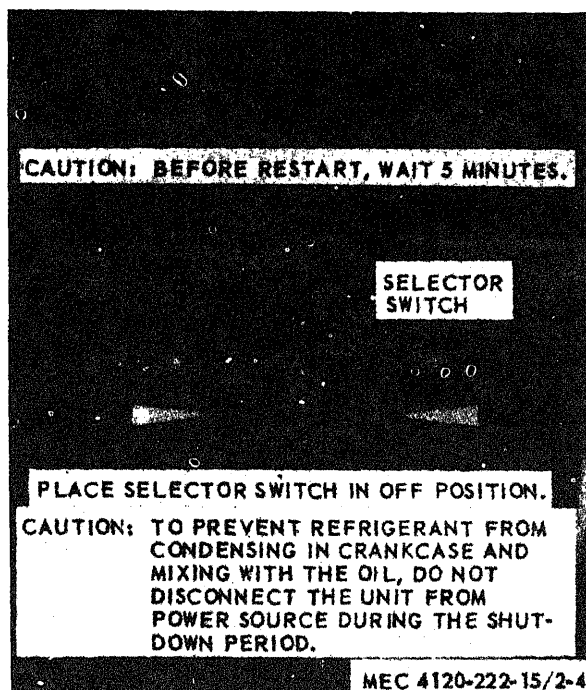
**Caution:** Wait 5 minutes before restarting the unit after operation.

## 2-10. Stopping

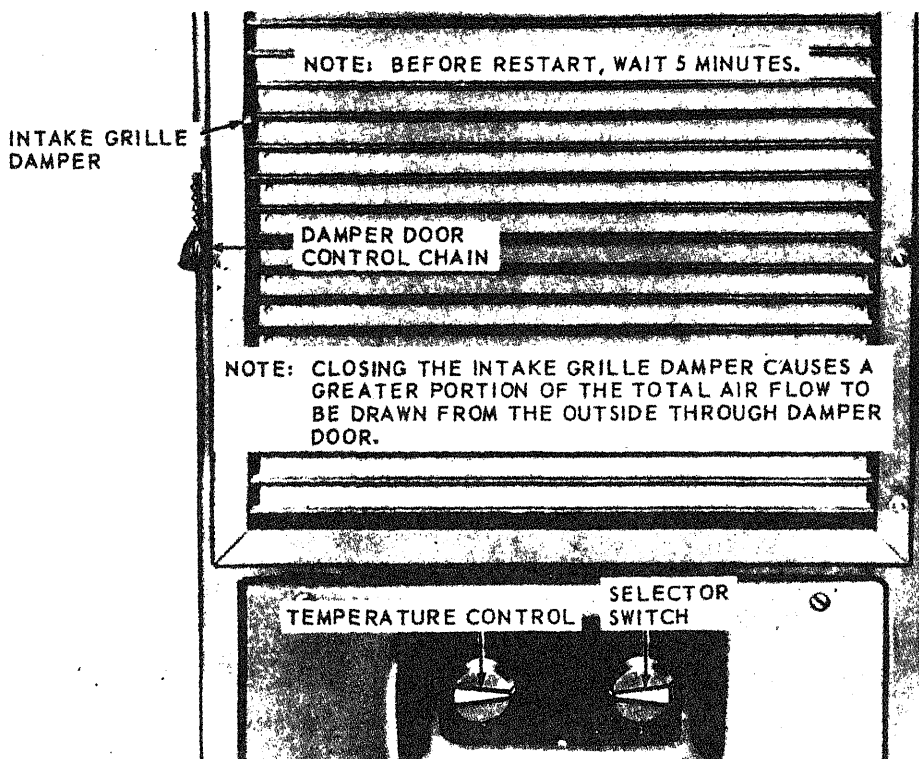
Refer to figure 2-4, and stop the air conditioner.

## 2-11. Operation of Equipment

Refer to figure 2-5 for instructions on operation of the air conditioner.







**A. COOLING OPERATION:**

- STEP 1. POSITION TEMPERATURE CONTROL FOR DESIRED TEMPERATURE.
- STEP 2. PLACE SELECTOR SWITCH ON COOL POSITION.
- STEP 3. FOR COOLING WITH 100 PERCENT RECIRCULATED AIR, CLOSE DAMPER DOOR AND OPEN INTAKE GRILLE DAMPER.
- STEP 4. FOR COOLING WITH FRESH MAKEUP AIR, OPEN DAMPER DOOR AND PARTIALLY CLOSE INTAKE GRILLE DAMPER.
- STEP 5. FOR COOLING WITH FRESH MAKEUP AIR DRAWN THROUGH CHEMICAL, BIOLOGICAL, FILTER UNIT WHEN OUTDOOR AIR IS CONTAMINATED, CLOSE DAMPER DOOR AND PARTIALLY CLOSE INTAKE GRILLE DAMPER.

**B. HEATING OPERATION:**

- STEP 1. POSITION TEMPERATURE CONTROL FOR DESIRED TEMPERATURE.
- STEP 2. PLACE SELECTOR SWITCH ON LO HEAT OR HI HEAT POSITION.
- STEP 3. FOR HEATING WITH 100 PERCENT RECIRCULATED AIR, CLOSE DAMPER DOOR AND OPEN INTAKE GRILLE DAMPER.
- STEP 4. FOR HEATING WITH FRESH MAKEUP AIR, OPEN DAMPER DOOR AND PARTIALLY CLOSE INTAKE GRILLE DAMPER.
- STEP 5. FOR HEATING WITH FRESH MAKEUP AIR DRAWN THROUGH CHEMICAL, BIOLOGICAL, FILTER UNIT WHEN OUTDOOR AIR IS CONTAMINATED, CLOSE DAMPER DOOR AND PARTIALLY CLOSE INTAKE GRILLE DAMPER.

**C. VENTILATING OPERATION:**

- STEP 1. PLACE SELECTOR SWITCH IN VENTILATE POSITION.
- STEP 2. FOR VENTILATING OPERATION, OPEN DAMPER DOOR AND CLOSE INTAKE GRILLE DAMPER.

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*Figure 2-5. Operating instructions.*

## Section V. OPERATION UNDER UNUSUAL CONDITIONS

### 2-12. Operation in Extreme Cold

*a. General.* The air conditioner is designed to operate at a maximum low temperature of  $-65^{\circ}\text{F}$ , (Fahrenheit). Be sure that all thermostatic controls and dampers are in working order.

*b. Electrical System.* Make sure the electrical system is free of ice and moisture.

*Caution:* Do not disturb the wiring during cold weather unless absolutely necessary. Cold temperatures make wiring and insulation brittle and easily broken.

### 2-13. Operation in Extreme Heat

*a. General.* The air conditioner is designed to

operate satisfactorily at temperatures up to 125°F.

b. *Ventilation.* Allow sufficient room around the air conditioner for adequate air circulation.

*Caution.* Do not restrict the flow of air at the intake and discharge openings of the unit.

#### **2-14. Operation in Dusty or Sandy Areas**

Clean the condenser coil and evaporator coil weekly or more often if necessary. Clean the mist eliminator, air conditioning filter, and condenser screen, daily.

#### **2-15. Operation Under Rainy or Humid Conditions**

If the unit is outside and not operating, protect it with a canvas or other waterproof material. Remove cover during dry periods. Open the front access panel to allow unit to dry before operating. Use caution when operating electrical equipment.

#### **2-16. Operation in Salt Water Areas**

Wash the exterior of the unit with clean, fresh water at frequent intervals. Do not damage the electrical equipment during the cleaning operation. Coat exposed metal surfaces with rust proofing material. Remove corrosion and paint the exposed metal surface.

## CHAPTER 3

# OPERATOR'S AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

### Section I. OPERATOR'S AND ORGANIZATIONAL MAINTENANCE REPAIR PARTS, TOOLS AND EQUIPMENT

#### 3-1. Tools and Equipment

Basic issue tools and repair parts issued with or authorized for the air conditioner are listed in the Basic Issue Items List, Appendix B of this manual.

#### 3-2. Organizational Maintenance Repair Parts

Organizational maintenance repair parts are listed and illustrated in TM 5-4120-222-24P.

*Note.* This unit requires no lubrication.

### Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

#### 3-3. General

To insure that the air conditioner is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive checks and services to be performed are listed and described in table 3-1. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a

deficiency is noted during operation, which would damage the equipment if operation were continued. All deficiencies and shortcomings will be recorded together with the corrective action taken on DA Form 2404 at the earliest possible opportunity.

#### 3-4. Preventive Maintenance Checks and Services

Refer to table 3-1 for daily and quarterly preventive maintenance checks and services.

*Table 3-1. Preventive Maintenance Checks and Services*

Item Number	Interval						B—Before Operation D—During Operation	A—After Operation W—Weekly	M—Monthly Q—Quarterly
	Operator			ORG.					
	Daily			W	M	Q			
	B	D	A						
							Item to be Inspected	Procedure	Reference
1			X			X*	Air inlet filter.....	Wash and dry fresh air inlet filter. Tighten loose mounting. *Replace a damaged filter.	Paragraph 3-9
2			X			X*	Air conditioner filter..	Clean air conditioning filter. *Tighten loose mounting. Replace a damaged filter.	Paragraph 3-7
3			X			X*	Controls.....	Check for damage and proper operation. *Tighten loose mountings.	
4			X				Condenser screen....	Clean condenser screen.	
5						X	Sight glass.....	Check for damage or broken glass. Check for full condition of unit.	Paragraph 2-7
6						X	Fan.....	Tighten loose mounting. Check for damage. Replace a damaged fan.	Paragraph 3-20 and 3-21
Note. During operation observe for any unusual noise or vibration.									

The instructions in this section are published for the information and guidance of the operator to maintain the air conditioner.

**Warning:** Disconnect the air conditioner from the power source before performing any maintenance on the components of the unit.

### 3-6. Mist Eliminator Service

a. *General.* The mist eliminator is located under the top panel, between the evaporator air discharge grille and the evaporator coil. It removes moisture from the air after it has passed over the evaporator coil, thereby reducing the amount of moisture in air discharged into the conditioned area.

b. *Removal.* Remove the cover panel and discharge grille (para 3-17).

c. *Servicing.* Refer to figure 3-1 and service the mist eliminator.

d. *Installation.* Refer to paragraph 3-17, and install cover panel and discharge grille.

### 3-7. Filter, Air Conditioning Service

a. *Removal.* Remove the intake grille (para 3-17).

b. *Servicing.* Refer to figure 3-1 and service the air conditioning filter.

c. *Installation.* Install intake grille in reverse order of removal (para 3-17).

### 3-8. Evaporator Coil and Condenser Coil Service

a. *Removal.* Refer to paragraph 3-18 and remove mist eliminator. Refer to paragraph 3-19, and remove condenser coil grille and screen.

b. *Servicing.* Refer to figure 3-2 and service the evaporator coil and condenser coil.

c. *Installation.* Install condenser coil grille and screen and mist eliminator in reverse order of removal (para 3-18 and 3-19).

### 3-9. Servicing Fresh Air Inlet Filter

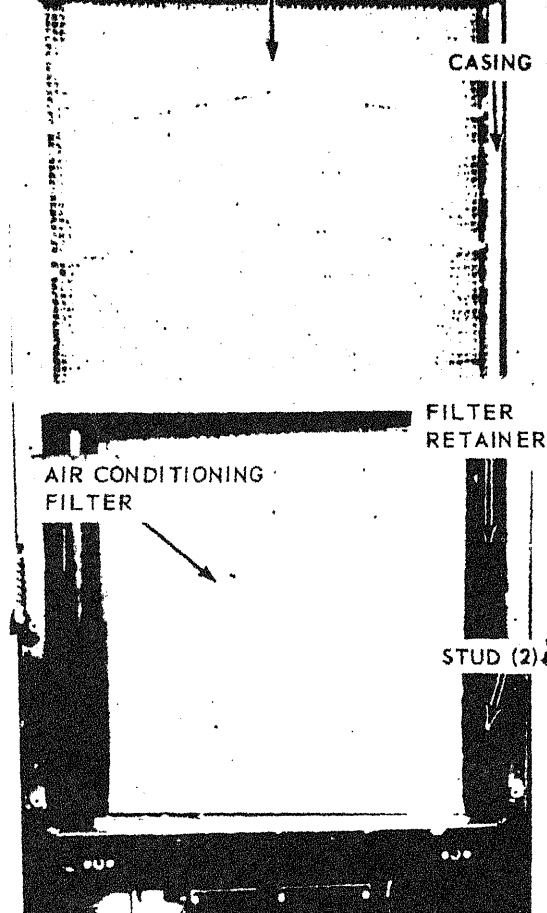
a. *Removal.* Remove the fresh air inlet screen (para 3-19).

b. *Servicing.* Clean with compressed air. Replace damaged filter.

c. *Installation.* Refer to paragraph 3-19 and install the fresh air inlet screen.

### 3-10. Fuse Replacement

a. *General.* The earlier Models of CE20VAL6



- STEP 1. LIFT MIST ELIMINATOR FROM CASING.
- STEP 2. REMOVE STUD (2), FILTER RETAINER, AND AIR CONDITIONING FILTER.
- STEP 3. WASH FILTER AND MIST ELIMINATOR WITH AN APPROVED CLEANING SOLVENT AND DRY WITH CLEAN, LOW-PRESSURE COMPRESSED AIR.
- STEP 4. DIP OR SPRAY FILTER WITH FILTERKOTE OR OIL OF SPECIFICATION MILITARY 0-2104 GRADE 20, 30, OR BETTER. DRAIN OFF EXCESS OIL BEFORE INSTALLATION.
- STEP 5. REINSTALL AIR FILTER MIST ELIMINATOR IN ACCORDANCE WITH STAMPED ARROW DIRECTION.

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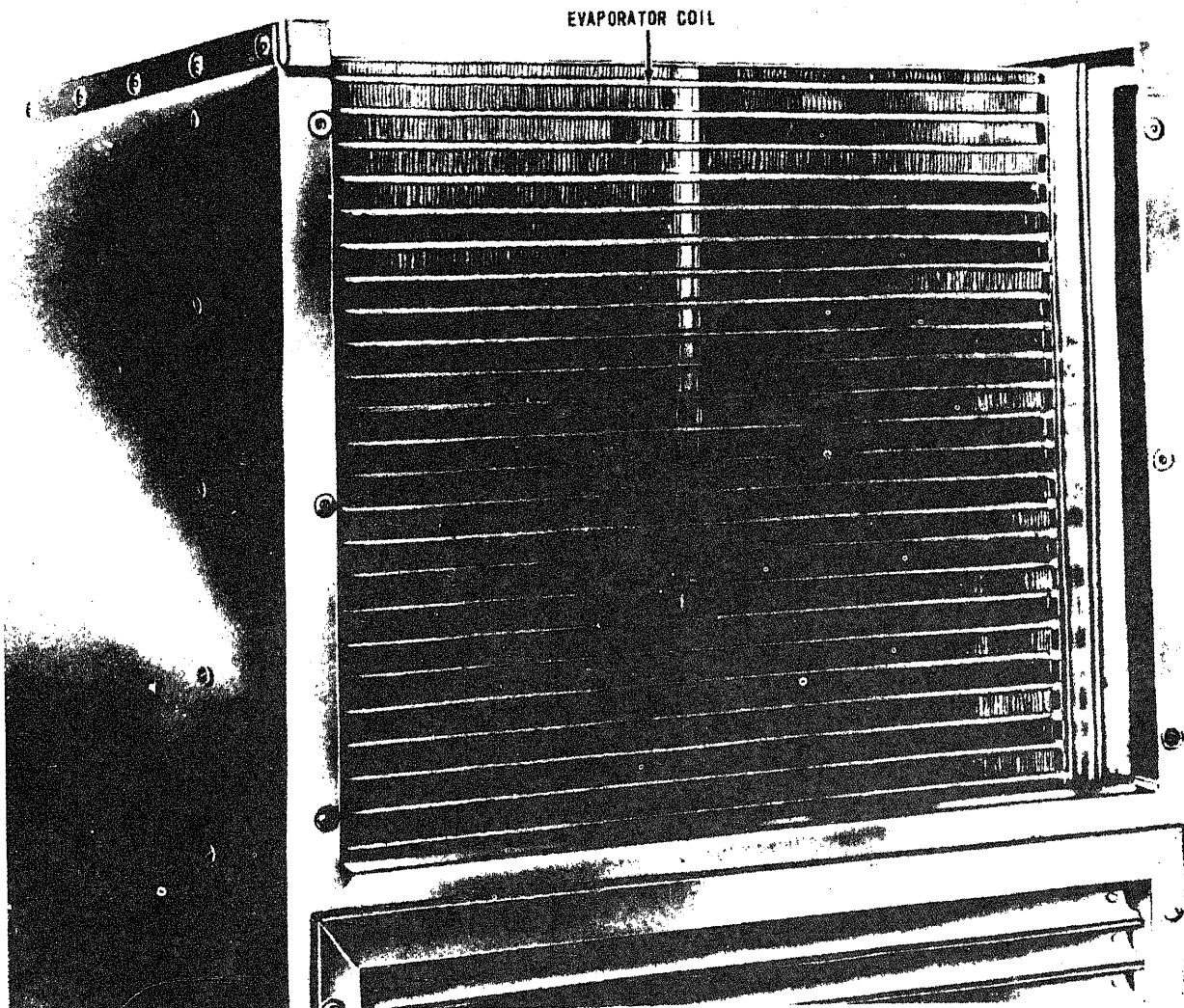
Figure 3-1. Servicing mist eliminator and air conditioning filter.

and CE20VAL4 have no fuses. The new models have two 5-amp cartridge fuses mounted in the upper right corner of the control box.

b. *Removal.* Remove fuses from fuse holder.

c. *Installation.* Snap in new fuses of proper amperage and size.

d. *Testing.* Use an ohmmeter and test fuse for open.



TO SERVICE  
 STEP 1 CLEAN SURFACE OF COIL WITH A SUITABLE BRUSH  
 STEP 2 CLEAN BETWEEN FINS WITH LOW-PRESSURE, COMPRESSED AIR  
 NOTE SERVICE CONDENSER COIL IN A SIMILAR MANNER

MSC 4120 222-15 13

Figure 3-2. Servicing evaporator coil and condenser coil.

## Section IV. TROUBLESHOOTING

### 3-11. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the air conditioner.

### 3-12. Troubleshooting Procedure

Malfunctions which may occur are listed in table 3-2. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 3-2. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Compressor fails to start.....	a. Selector switch improperly adjusted..... b. Circuit breaker contacts open..... c. Contacts of high pressure cutout switch open.	a. Set switch to COOL position. b. Reset circuit breaker. c. Push reset button to reset cutout switch

Table 3-2. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
2. Compressor starts but goes out on overload.	a. Temperature control setting too low.... b. Suction pressure too low.....  c. Discharge pressure too high..... d. Blower motor defective.....	a. Raise temperature control setting. b. Service the mist eliminator, air conditioning filter, condenser screen, and condenser and evaporator coils (paras 3-6, 3-7, and 3-8). c. Service the evaporator and condenser coils (para 3-8). d. Replace motor (para 3-25).
3. Little or no heating capacity.....	a. Selector switch improperly adjusted..... b. Air movement over evaporator insufficient.	a. Adjust switch to proper setting. b. Service the mist eliminator, air conditioning filter, condenser screen, condenser and evaporator coils (paras 3-6, 3-7, and 3-8).
4. Suction pressure inadequate.....	a. Temperature control setting too low.... b. Air temperature in air conditioned space excessively low.	a. Raise temperature control setting. b. Service the mist eliminator, air conditioning filter, condenser screen, condenser and evaporator coils (paras 3-6, 3-7, and 3-8).
5. High discharge pressure.....	Insufficient volume of air passing through condenser coil.	Service condenser evaporator coils and screen (para 3-8).
6. Suction and discharge pressure low.	Lack of refrigerant.....	Check sight glass for appearance of bubbles. Report low refrigerant charge to direct support maintenance personnel.

## Section V. FIELD EXPEDIENT REPAIRS

### 3-13. General

Operator and organizational maintenance trouble may occur while the air conditioner is operating in the field where supplies and repair parts are not available and normal corrective action cannot be performed. When this condition exists, the following expedient repairs may be used in emergencies, upon the decision of the unit commander. Equipment so repaired must be removed from operation as soon as possible and properly repaired before being placed in operation again.

### 3-14. Compressor Inoperative

Trouble	Expedient Remedy
Compressor overload protector.	Bypass the protector by installing three insulated jumper wires between the connection terminals on the compressor (para 5-6).

*Note.* If compressor does not start when the air conditioner is connected to the power source, the compressor is defective and must be replaced. Report this condition to direct support maintenance.

### 3-15. Compressor Heater Inoperative

Trouble	Expedient Remedy
Compressor heater thermostat defective.	Disconnect thermostat from compressor power receptacle connector and from the heater. Connect the lead directly to the power receptacle lead. Refer to wiring diagrams.

*Note.* If the heater is not activated when the air conditioner is connected to the power source, the heater is defective and must be replaced. Report this condition to direct support maintenance.

### 3-16. General

The air conditioner is constructed with removable aluminum panels. The front access panel provides access to the control box, control panel, and charging valves. A discharge grille protects the evaporator and mist eliminator and controls the discharge of conditioned air. The intake grille protects the air conditioning filter and regulates the amount of air returned to the unit. The condenser coil grille and fan guard protects the condenser coil and fan. A fresh air inlet screen permits the entry of outside air and is controlled by the damper door with the control spring and chain. An intake cover provides for attachment of a Chemical and Biological Filter Unit. The cover panel covers the top of the unit.

**Warning:** Disconnect the air conditioner from the power source before performing any maintenance on the components of the unit.

### 3-17. Cover Panel, Discharge Grille, Intake Grille, and Front Access Panel

*a. Removal.* Refer to figure 3-3 and remove the cover panel, discharge grille, intake grille, and front access panel.

*b. Installation.* Install the cover panel, discharge grille, intake grille, and front access panel in reverse order of removal as illustrated on figure 3-3.

### 3-18. Mist Eliminator and Air Conditioning Filter

*a. Removal.* Refer to figure 3-4 and remove the mist eliminator and air conditioning filter.

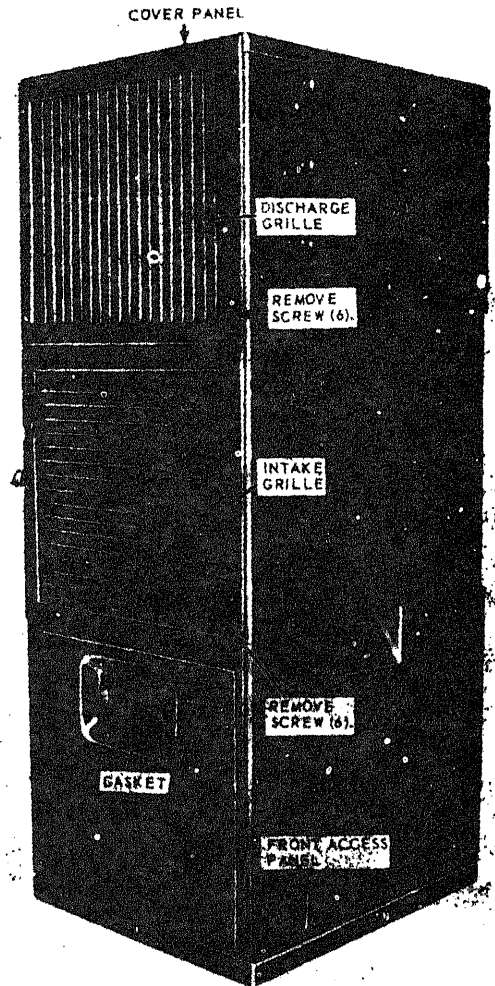
*b. Installation.* Replace defective mist eliminator and filter. Refer to figure 3-4 and install the mist eliminator and air conditioning filter in reverse removal order.

### 3-19. Fresh Air Inlet Screen, Chemical and Biological Cover, Fan Guard, and Condenser Coil Grille and Screen

*a. Removal.* Refer to figure 3-5 and remove the fresh air inlet screen, C B (chemical and biological) cover, fan guard, and condenser coil grille and screen.

*b. Installation.* Install the fresh air inlet screen, C B cover, fan guard, and condenser coil grille and screen in reverse order of removal as illustrated on figure 3-5.

NOTE: REMOVE SCREW FROM COVER PANEL.



NOTE: REPLACE COVER PANEL INSULATION, FRONT ACCESS PANEL GASKET, AND RIVET NUTS IF DAMAGED OR DEFECTIVE.

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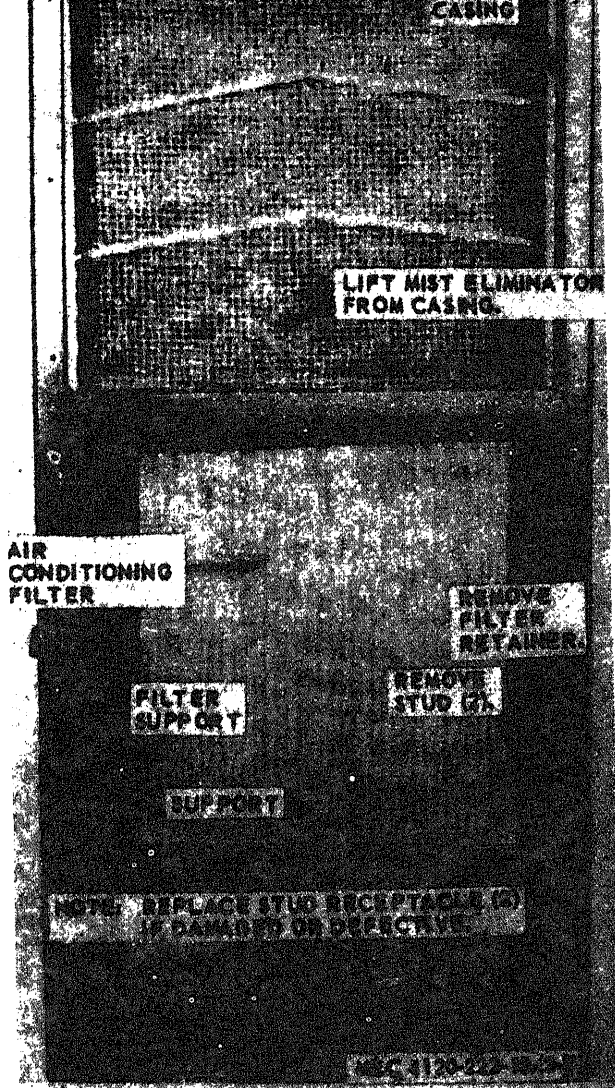
Figure 3-3. Cover panel, discharge grille, intake grille, and front access panel, removal and installation.

### 3-20. Evaporator Fan and Inlet Ring

*a. General.* New models of CE20VAL6 and CE20VAL4 air conditioner have air foil evaporator fan. The air foil fan reduces excessive vibration and noise.

*b. Removal.* Refer to figure 3-6 and remove the inlet ring and evaporator fan.

*c. Installation.* Install the inlet ring and evaporator fan in reverse order of removal as illustrated on figure 3-6.



**Figure 3-4. Mist eliminator and air conditioning filter, removal and installation.**

*a. General.* The condenser fan, figure 3-7 (1), has been replaced on new model air conditioners with an air foil fan and baffle, figure 3-7(2). The air foil fan and baffle reduces excessive vibration and noise.

*b. Removal.* Refer to figure 3-7 and remove the condenser fan.

*c. Installation.* Install the condenser fan in reverse order of removal as illustrated on figure 3-7.

### **3-22. Damper Door Control Spring and Chain**

*a. General.* The damper door control should give continuous service with little attention. Should the spring malfunction, replacement is simple as is chain replacement.

*b. Removal.*

(1) Remove the air intake grille (para 3-17).

(2) Disconnect spring from the clip and chain.

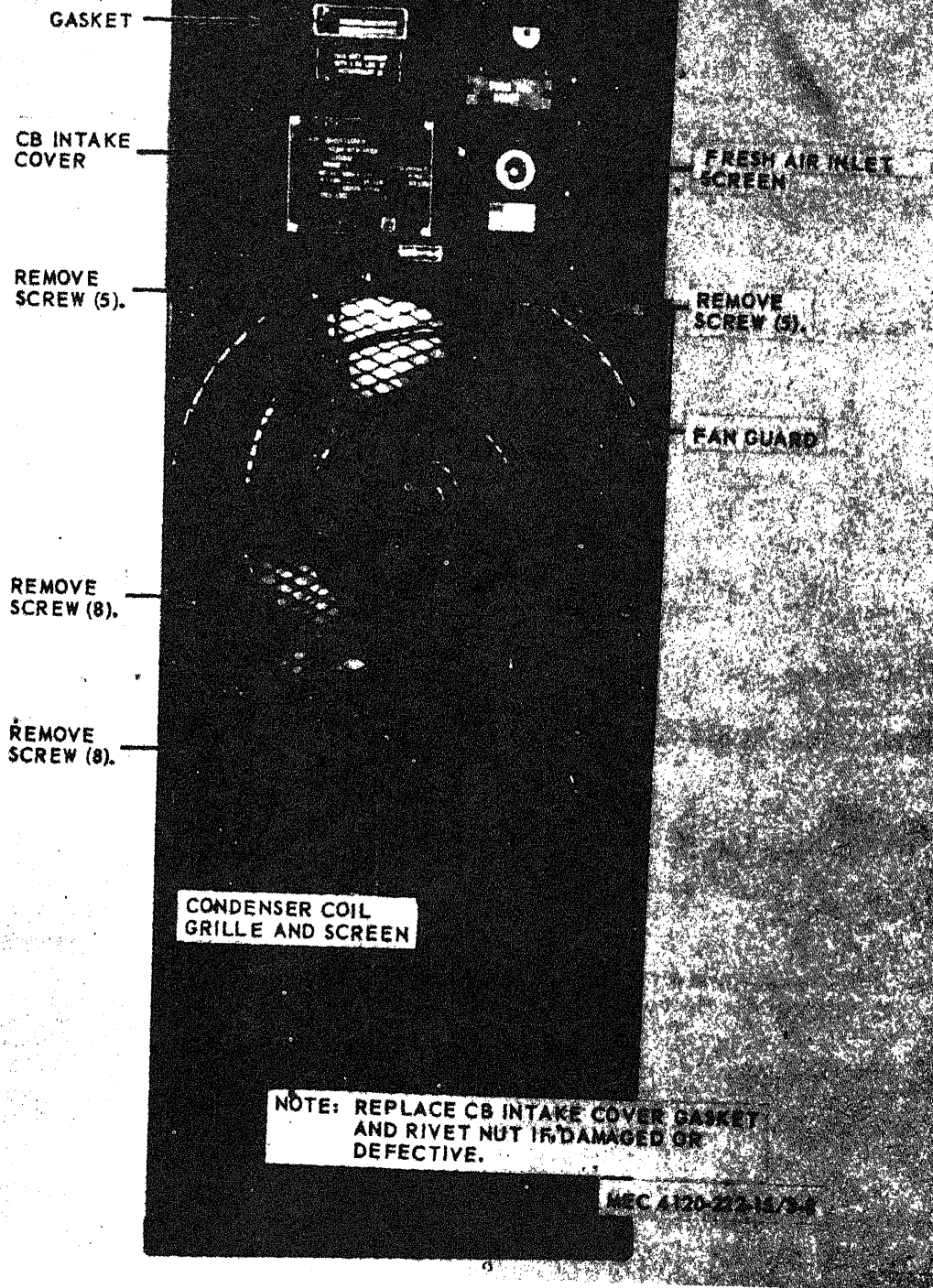
(3) Disconnect chain from clip and remove chain from front of unit.

(4) Remove pendent from chain if required.

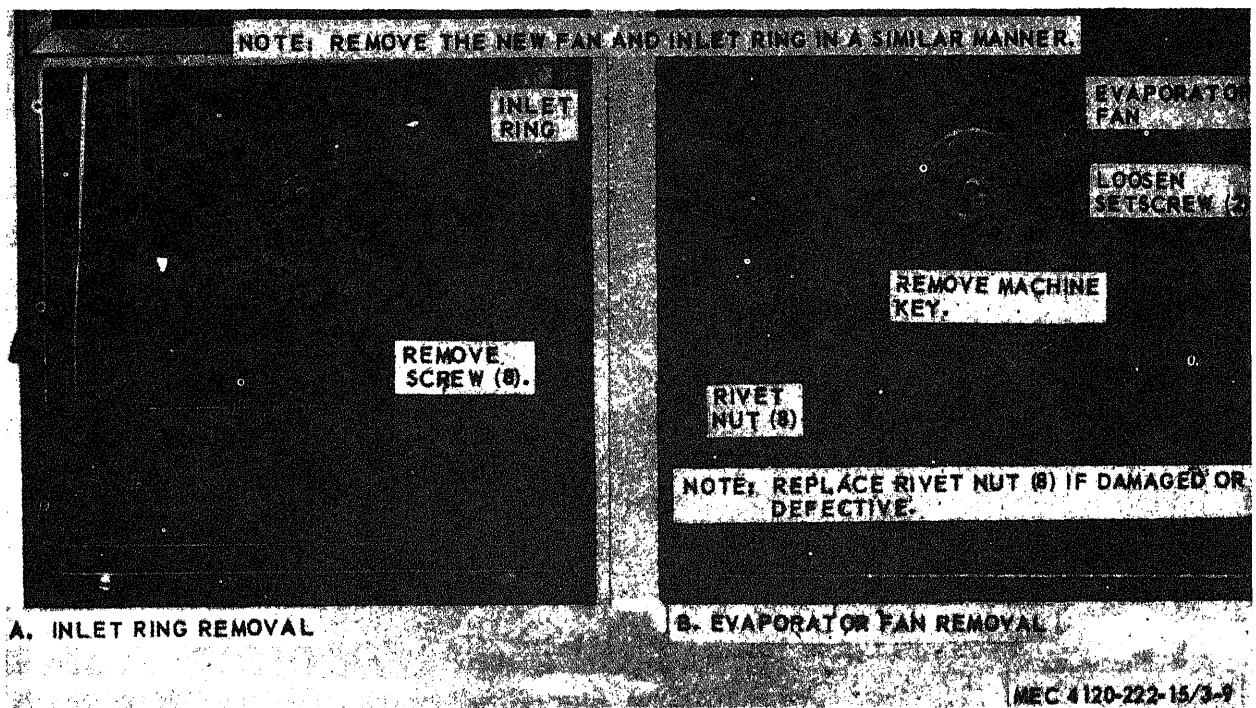
*c. Installation.* Install replacement parts by reversing order of disassembly.

*Note.* Inspect the panels, grilles, screens, fan guard, mist eliminator, damper door control spring and chain for breaks, cracks, or other damage.

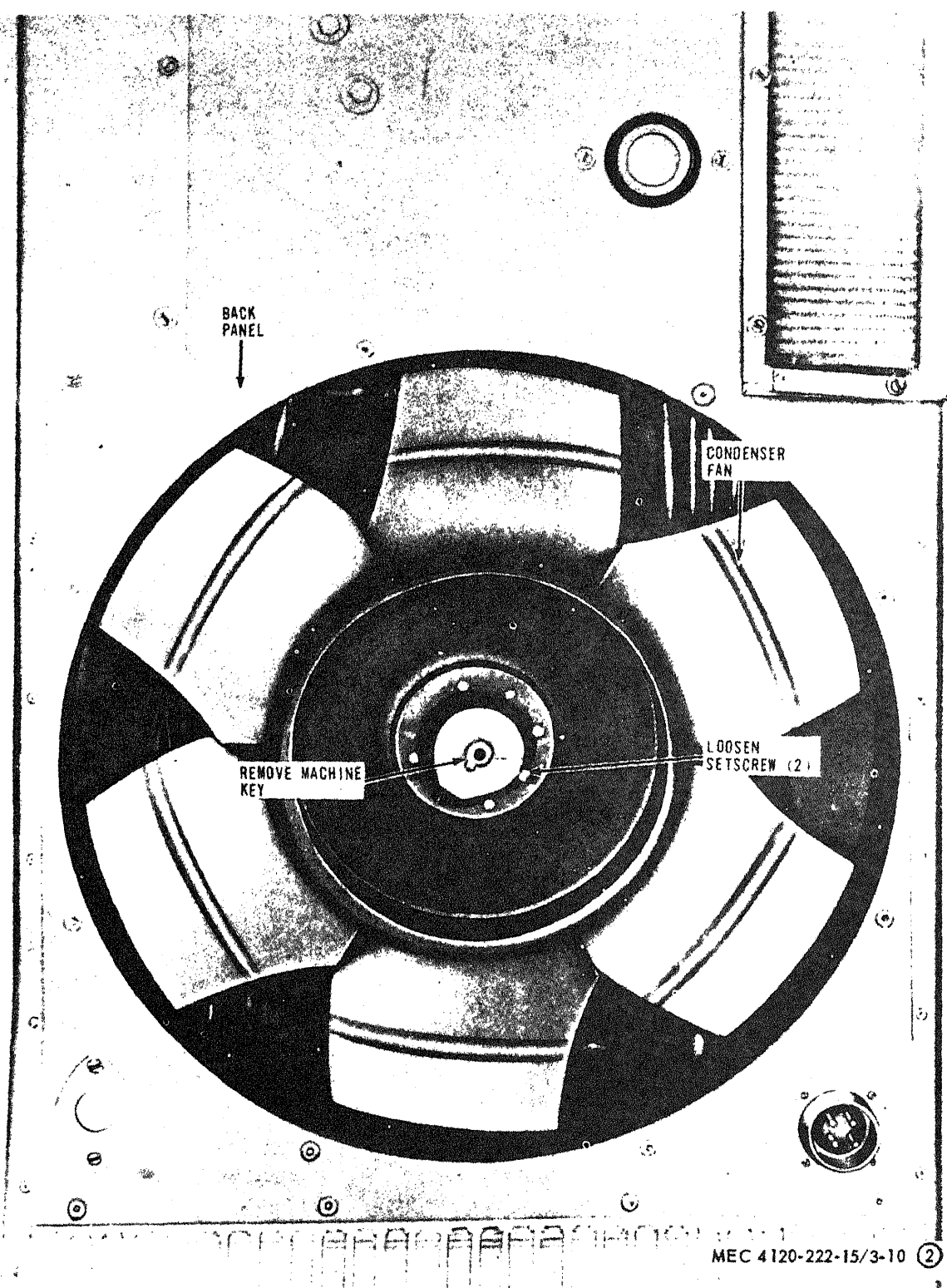




*Figure 3-5. Fresh air inlet screen, chemical and biological cover, fan guard, and condenser grille and screen, removal and installation.*



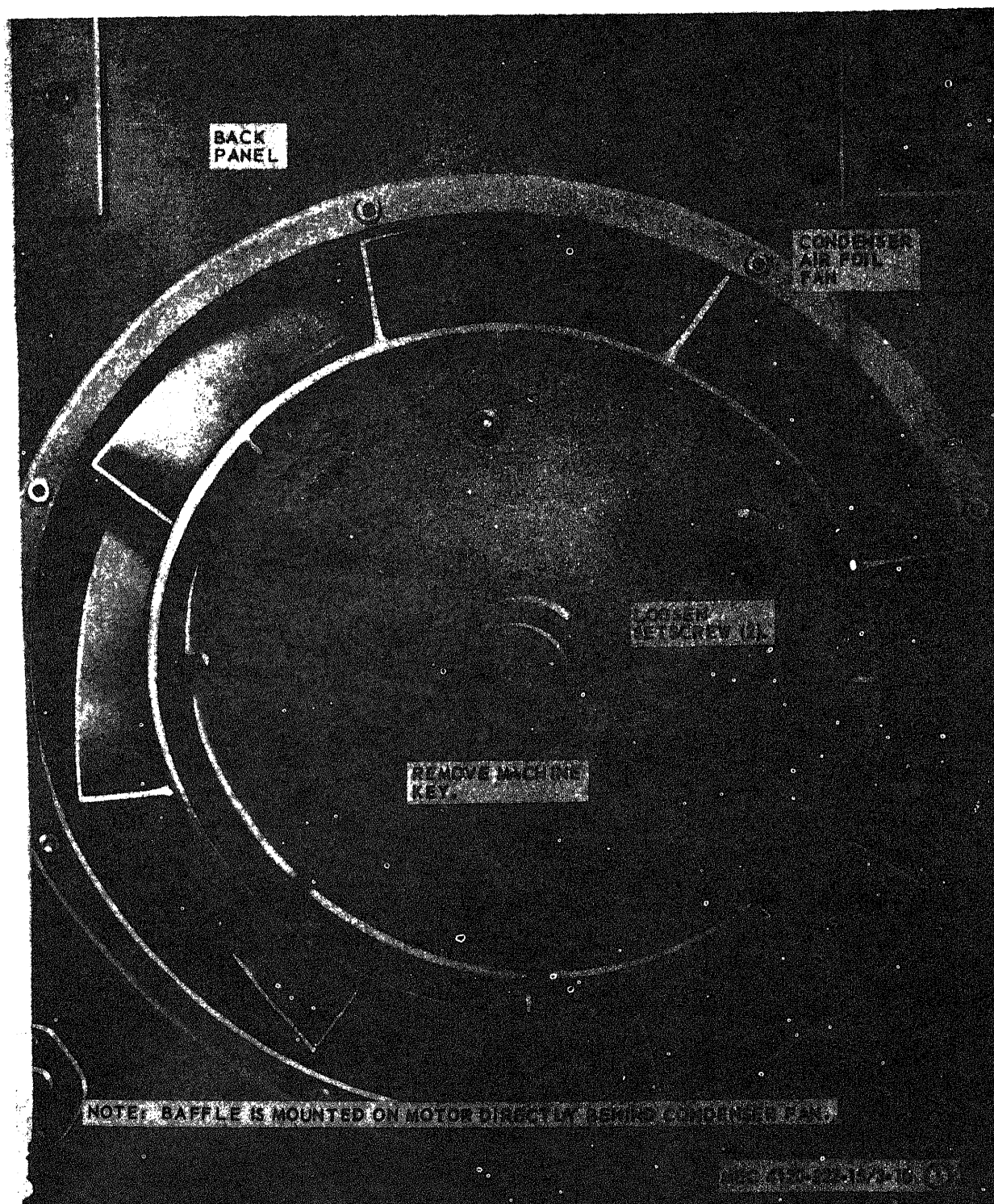
*Figure 3-6. Evaporator fan inlet ring removal and installation.*



(1) Earlier type

Figure 3-7. Condenser fan removal and installation.

Figure 3-7. Condenser fan (earlier type) removal and installation. (Sheet 1 of 2)



(2)

Figure 3-7—Continued.

Figure 3-7. Condenser fan removal and installation. (Sheet 2 of 2)

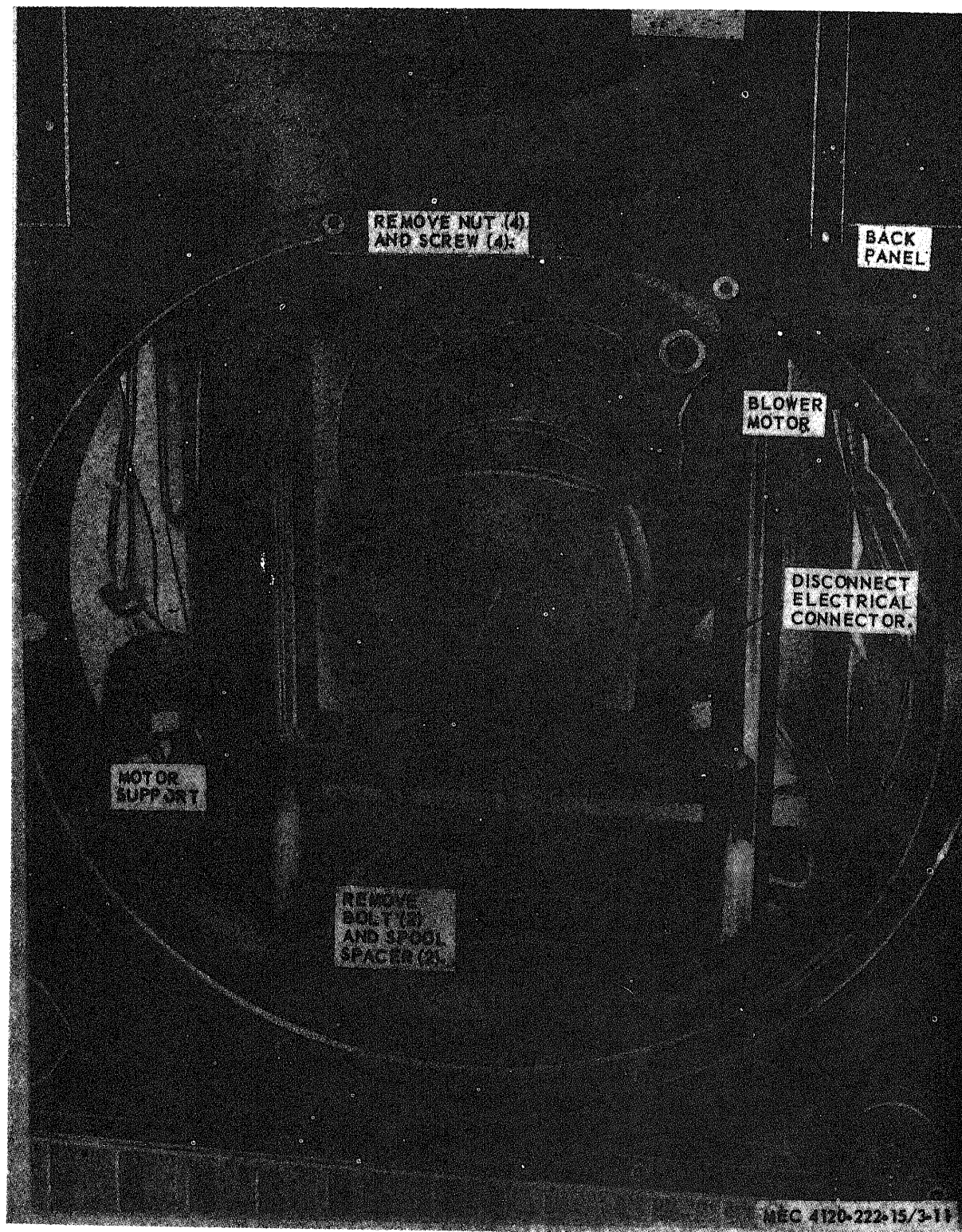


## Section VII. ELECTRICAL SYSTEM AND BLOWER MOTOR

### 3-23. General

The electrical system (fig. 1-4) consist of the compressor, blower motor, selector switch, relay, rectifier, contactors, fuses, heaters, evaporator

heater thermostat, thermostatic switch, and all internal wiring. A compressor overload protector prevents the compressor from being damaged by electrical overload. The compressor heater ther-



*Figure 3-8. Blower motor, removal and installation.*

mostat cuts off the power to the compressor heater when the compressor reaches safe operating temperature and also activates the heater when required. Both fans are driven by the blower motor which has integral overload protection. The evaporator heater thermostat prevents overheating when the unit is operating on the heating cycle. A thermostatic switch prevents the compressor from being started when the outdoor temperature is below 50°F.

### **3-24. Electrical Leads**

When removing or replacing components of the air conditioner, always inspect condition of all wires and cables. Repair or replace any defective wiring. (See wiring diagram.)

### **3-25. Blower Motor**

*a. Removal.* Refer to figure 3-8 and remove the blower motor.

*b. Installation.* Install the motor in reverse order of removal as illustrated on figure 3-8.

## CHAPTER 4

### DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

#### Section I. GENERAL

##### 4-1. Scope

These instructions are for direct and general support maintenance personnel. They contain information on equipment maintenance that is beyond the scope of the tools, equipment, personnel, or

supplies normally available to organizational maintenance personnel.

##### 4-2. Forms and Records

Refer to paragraph 1-2 for forms and records applicable to this equipment.

#### Section II. DESCRIPTION AND DATA

##### 4-3. Description

For a complete description of the air conditioner refer to paragraph 1-3.

##### 4-4. Tabulated Data

The tabulated data applicable to the air conditioner is referenced in paragraph 1-4.

#### Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

##### 4-5. Special Tools and Equipment

No special tools or equipment are required to perform direct and general support maintenance on the air conditioner.

parts are listed and illustrated in TM 5-4120-222-24P.

##### 4-6. Direct and General Support Maintenance Repair Parts

Direct and general support maintenance repair

##### 4-7. Specially Designed (Fabricated) Tools and Equipment

No specially designed (fabricated) tools or equipment are required to perform direct or general support maintenance on the air conditioner.

#### Section IV. TROUBLESHOOTING

##### 4-8. General

This section provides information useful to direct and general support maintenance personnel in diagnosing and correcting unsatisfactory operation or failure of the air conditioner.

##### 4-9. Troubleshooting Procedure

Malfunctions which may occur are listed in table 4-1. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 4-1. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Compressor fails to start.....	a. Circuit breaker defective..... b. Compressor defective..... c. Wiring and wiring harness defective..... d. Temperature control defective.....	a. Replace (para 5-12). b. Replace (para 5-30). c. Replace (para 5-19). d. Replace (para 5-9).

Table 4-1. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
	e. Compressor motor and evaporator heater contactors defective. f. Compressor overload protector defective. g. Thermostatic switch defective..... h. Phase sequence relay contacts open.....	e. Replace contactor (para 5-15). f. Replace protector (para 5-6). g. Replace (para 5-7). h. Interchange two lines wires to reverse phase sequence.
2. Compressor starts but goes out on overload.	a. Expansion valve defective..... b. Discharge pressure too high..... c. Compressor defective.....	a. Replace (para 5-21). b. Remove small amount of refrigerant charge (para 5-33). c. Replace (para 5-30).
3. Little or no heating capacity.....	a. Wiring and wiring harness defective.... b. Blower motor defective.....	a. Replace wiring or wiring harness (para 5-19). b. Repair (para 5-4).
4. Suction pressure inadequate.....	a. Expansion valve not adjusted properly.. b. Expansion valve defective..... c. Dehydrator defective.....	a. Adjust (para 5-21). b. Replace (para 5-21). c. Replace (para 5-25).
5. Discharge pressure inadequate.....	Compressor defective.....	Replace (para 5-30).
6. Suction pressure too high.....	a. Liquid line bypass solenoid valve defective. b. Hot gas bypass solenoid valve defective.. c. Superheat adjustment incorrect..... d. Expansion valve defective..... e. Compressor defective.....	a. Replace valve (para 5-24). b. Replace valve (para 5-23). c. Adjust thermostatic expansion valve (para 5-21). d. Replace (para 5-21). e. Replace (para 5-30).
7. Discharge pressure too high.....	Overcharge of refrigerant.....	Remove small amount of refrigerant charge (para 5-33).
8. Suction and discharge pressure low..	Lack of refrigerant.....	Check refrigerant level in sight glass. Test for leaks and charge system (para 5-33).
9. High suction pressure with low discharge pressure.	Compressor defective.....	Replace (para 5-30).
10. System losing cooling capacity.....	System operating pressure incorrect.....	Install pressure gages on gage parts of suction and discharge line charging valves and turn valves two turns to open, exposing gages to system pressure. Compare gage readings with normal ranges of system pressures listed in tble 4-2.

Table 4-2. Normal Operating Pressures

90°F. DB RETURN AIR TO UNIT

Outdoor ambient temperature	50°F.	75°F.	100°F.	125°F.
<b>GAGE PRESSURE:</b>				
Suction.....	58-60	58-65	65-75	75-90
Discharge.....	135-155	185-205	275-295	400-420

Table 4-2. Normal Operating Pressures

80°F. DB RETURN AIR TO UNIT

Outdoor ambient temperature	50°F.	75°F.	100°F.	125°F.
<b>GAGE PRESSURE:</b>				
Suction.....	58	58	58-65	65-75
Discharge.....	130-150	180-200	270-290	390-410



## CHAPTER 5

### REPAIR INSTRUCTIONS

#### Section I. GENERAL

##### 5-1. General

The air conditioner, after it is started, is automatic in operation. The relationship of the automatic components, controls, and instruments, is explained in the operation analysis for maintenance of the air conditioner (para 5-2). A refrigerant flow diagram (fig. 5-1) and practical wiring diagrams (fig. 1-4) are included to assist in the maintenance of the electrical components, wiring harness, wire leads, and refrigerant components.

**Warning:** Disconnect the air conditioner from the power source before performing any maintenance on the components of the unit.

##### 5-2. Analysis of Operation

*a. General.* The type and degree of air conditioning provided by the unit is controlled by a five-position selector switch and a temperature control (temperature control thermostat).

(1) On units with Whirlpool compressors when the selector switch is in the OFF position the entire circuit is dead. On units with the Bendix-Westinghouse compressors the crankcase heater is in constant operation, being cycled on and off as required by its thermostat.

(2) Placing the selector switch in the HI-HEAT position actuates the blower motor with the two banks of evaporator heaters being under the control of the temperature control. If the air temperature falls below the set point of the temperature control, the control contacts close, energizing the evaporator contactor which supplies power to the heaters through the normally closed contacts of the evaporator heater thermostat.

(3) Moving the selector switch to the LO-HEAT position presents the same control sequence but reduces the heating capacity of the unit by supplying power to a single bank of heaters only.

(4) The blower motor starts when the selector switch is placed in the VENTILATE position.

(5) In the COOL position, the blower motor is in operation and the compressor motor contactor is energized through the contacts of the thermostatic switch. The energized contactor supplies power to the compressor through the normally closed contacts of the circuit breaker and the compressor overload protector. After the blower motor and compressor have started, the flow within the refrigerant circuit is controlled by the temperature control. Sensing a rise in the air temperature above the set point, the temperature control opens its contacts, deenergizing the solenoid valves. This positions the valves for cooling service. Sensing a fall in the air temperature below the set point, the contacts of the temperature control close, energizing the valves. This positions the valves for bypass service.

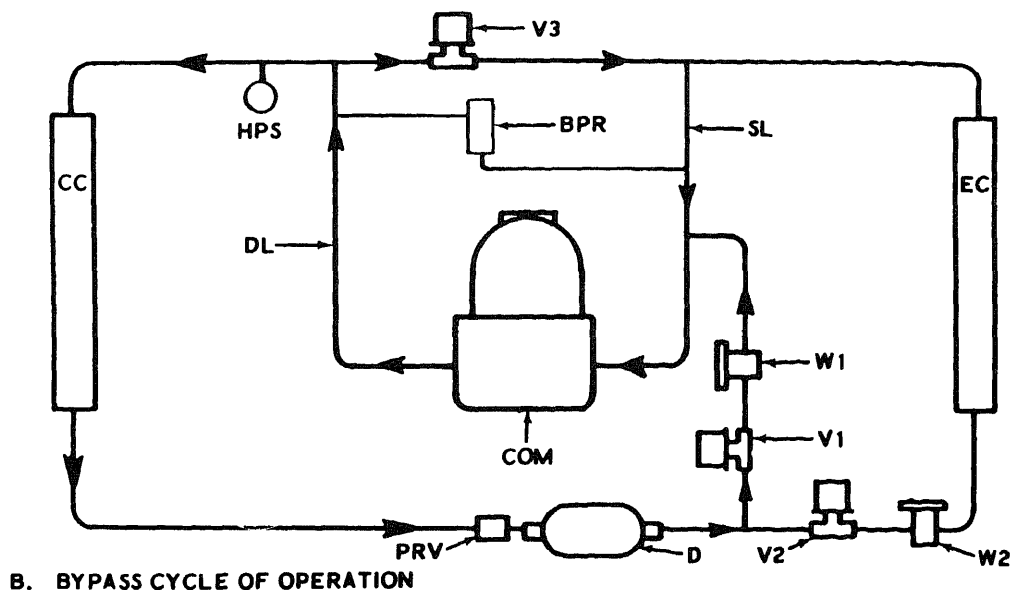
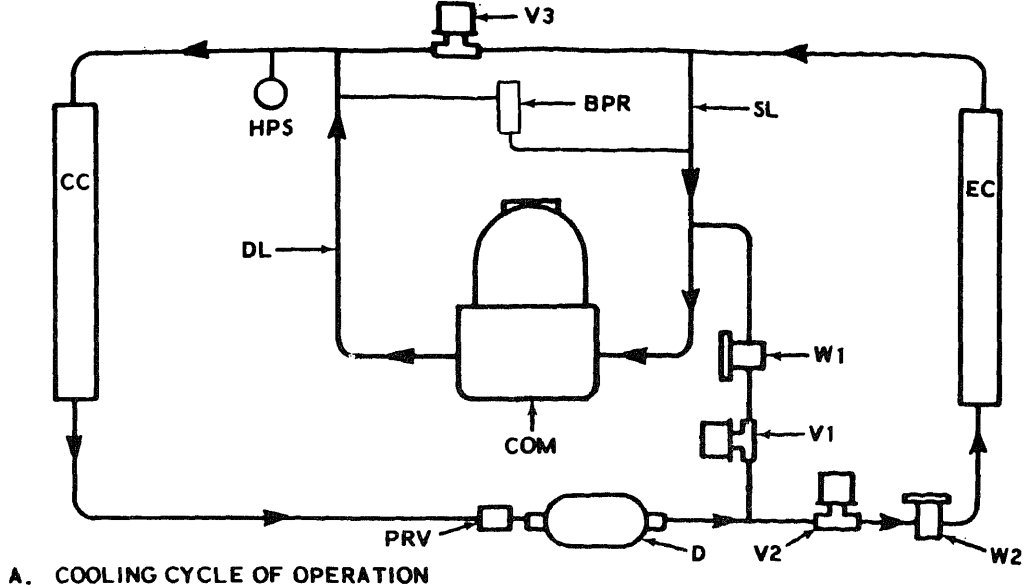
*b. Cooling Cycle of Operation.* The blower motor and compressor run continuously, whether the temperature control is calling for cooling or not when the unit is adjusted to operate on the cooling cycle of operation. This feature provides a constant electrical load thus preventing voltage fluctuations within the system.

*c. Bypass Cycle of Operation.* When the conditioned air temperature falls below the temperature control setting, the circuit which controls the solenoid valves is energized causing:

(1) The liquid line solenoid valve (V2) to close, stopping the flow of refrigerant to the evaporator coil, thus stopping the cooling function completely.

(2) The hot gas bypass line solenoid valve (V3) to open, bypassing a major part of the compressed refrigerant vapor directly back to the suction side of the compressor.

(3) The liquid line bypass solenoid valve (V1) to open, bypassing a small amount of liquid refrigerant, through an expansion valve, into the suction tubing.



**DEVICE LEGEND:**

BPR BACK PRESSURE REGULATOR  
 CC CONDENSER COIL  
 COM COMPRESSOR  
 D DEHYDRATOR  
 DL DISCHARGE LINE  
 EC EVAPORATOR COIL  
 HPS HIGH PRESSURE CUTOUT SWITCH  
 PRV PRESSURE RELIEF VALVE  
 SL SUCTION LINE

V1 LIQUID LINE BYPASS SOLENOID VALVE  
 V2 LIQUID LINE SOLENOID VALVE  
 V3 HOT GAS BYPASS SOLENOID VALVE  
 W1 ONE-HALF TON THERMOSTATIC EXPANSION VALVE  
 W2 ONE-TON THERMOSTATIC EXPANSION VALVE

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*Figure 5-1. Refrigerant flow diagram.*

(4) To prevent frost from forming on the evaporator, a back pressure regulating valve is provided to prevent the suction pressure from decreasing to a pressure which corresponds to a temperature of less than 32°F. (Fahrenheit).

*d. Heating Operation.* Placing the selector switch in the LO-HEAT position actuates half of the evaporator heaters mounted, in the conditioned air stream, directly behind the evaporator coil. When the selector switch is placed in the HI-

HEAT position, the remaining heaters are energized, providing maximum heating capacity (12,000 BTUH).

### 5-3. Repair Procedures

a. If the system must be opened for repair or replacement of parts, connect a hose line to the suction service valve and purge the refrigerant to an outside area.

b. After purging the system allow the tubing to warm to the ambient temperature before opening the system; this delay will help prevent the forma-

tion of condensation on the inside walls of the tubing. Plug or cap all openings as a part is removed to minimize the entry of dirt and moisture.

c. Use a silver solder on all soldered connections. Easy-Flo silver solder (or equivalent) with a 50 percent silver capacity and a melting point of approximately 1160°F. is recommended. Continually pass dry nitrogen through the tubing or connections being soldered to prevent formation of harmful copper oxides.

d. No metal to metal contact on capillary tubes is allowable; use tape to prevent such contact.

## Section II. REMOVAL AND INSTALLATION OF COMPONENTS

### 5-4. Blower Fan Motor

a. *On-Equipment Testing.* Before removing the motor for replacement, test the motor windings for opens and grounds:

(1) Disconnect receptacle connector from motor junction box.

(2) Test continuity across each combination of two motor terminals. Lack of continuity indicates an open winding.

(3) Place one contact of the tester against motor housing and the other against one of the motor terminals. If a circuit is indicated, the motor is grounded.

(4) Test the motor stator for insulation resistance as instructed in TM 5-764. The insulation resistance should measure not less than 0.5 megohms for the motor on either model.

*Note.* The resistance measurement should be used only as a general guide, taking into consideration the accuracy of the instrument used, test lead resistance, and ambient temperature at time of test. If more precise measurement is required, an instrument such as a Kelvin or Wheatstone bridge should be used, or comparative measurement between the suspected component and a like item known to be good should be utilized. In all cases where a megohmmeter is used for testing, make certain that the unit is thoroughly dry. Wet condemnation tolerances should be considered.

(5) Connect the motor leads to a proper source of power. Use a hook-type ammeter and read the amperage flowing in each of the motor leads. On Model CE20VAL4 the ammeter should indicate between 1.45 and 2.2 amperes at no load. The ammeter should indicate between 1.75 and 2.5 amperes at no load on Model CE20VAL6. Start the unit and check the ammeter reading. If the readings are not equal, the motor bearings are worn or the stator winding is defective. Follow the instructions in c below and disassemble the motor for further testing and repair.

b. *Removal.* Refer to paragraph 3-32, and remove blower motor.

c. *Disassembly.* Refer to figure 5-2, and disassemble the blower motor.

d. *Testing.*

(1) *Overload protector.* Disconnect the electrical leads from the overload protector. Test the protector with a multimeter set on OHMS. If continuity does not exist, replace the overload protector.

(2) *Motor bench test.* Perform the growler tests on the stator as instructed in TM 5-764. Replace a defective stator.

e. *Cleaning, Inspection and Repair.*

(1) Clean all parts with a cloth dampened in approved cleaning solvent.

(2) Inspect the stator housing for cracks, breaks, or other defects. Replace a damaged or defective housing.

(3) Inspect bearings for pits, scoring, wear, and out-of-round. Replace worn or defective bearings.

(4) Inspect the rotor shaft for cracks, wear, and misalignment. Replace a damaged or defective rotor.

(5) Inspect the rotor for cracks, breaks, and damaged laminations. Replace the rotor and stator if they are damaged. Replace the stator if it does not meet test standards (d above).

(6) Inspect all threaded parts for damage. Replace as necessary.

f. *Reassembly.* Refer to figure 5-2, and reassemble the blower motor.

g. *Installation.* Refer to paragraph 3-25, and install the blower motor.

### 5-5. Power Receptacle Connector

a. *Removal.* Refer to figure 5-3, and remove the power receptacle connector.

b. *Inspection.* Inspect connector for breaks, cracks, or other damage.

c. *Installation.* Replace defective receptacle and install the power receptacle connector in reverse removal order as illustrated in figure 5-3.

## 5-6. Compressor Overload Protector and Heater Thermostat

a. *Removal.* Refer to figure 5-4(1), and remove the compressor overload protector and heater thermostat from the Bendix-Westinghouse compressor assembly.

*Note.* The overload protector is not removable on the Whirlpool compressor. See figure 5-4 for wiring of Whirlpool model.

b. *Installation.* Replace defective parts as necessary and install the Bendix-Westinghouse compressor overload protector and heater thermostat in reverse order of removal as illustrated in figure 5-4.

c. *Field expedient repair.*

(1) Compressor overload protector. When the protector is defective, bypass it by installing three

insulated jumper wires between the connectic terminals on the compressor (see wiring diagram).

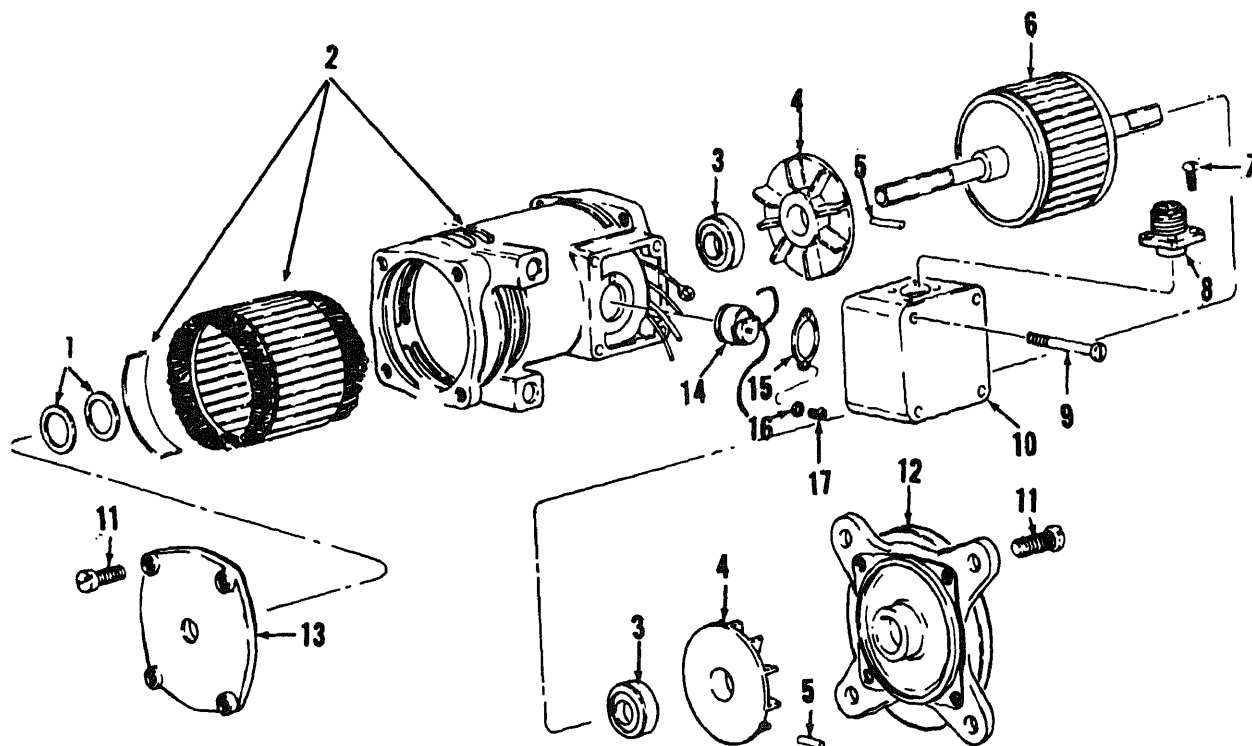
*Note.* If the compressor does not start whe the air conditioner is connected to the power source, th compressor is defective and must be replaced.

(2) *Compressor heater thermostat.* When th thermostat is defective, disconnect it from the compressor power receptacle and from the heater. Connect the heater lead directly to the power receptacle connector lead (see wiring diagram).

*Note.* If the heater is not activated when the air conditioner is connected to the power source, the heater is defective and must be replaced.

## 5-7. Outdoor Thermostat

a. *General.* The outdoor thermostat is mounted to the rear housing of the air conditioner. It prevents the compressor from being started when the outside temperature is below 50°F. This prevents the unit from being operated at a time when low condensing and suction pressures will hamper system operation.



NOTE: DISASSEMBLE THE BLOWER MOTOR ON THE MODEL CE20VAL6 AIR CONDITIONER IN A SIMILAR MANNER.

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- |                                |                             |                          |
|--------------------------------|-----------------------------|--------------------------|
| 1 Spring washer (spec) (2 rqr) | 7 Screw, machine            | 13 Housing cover endbell |
| 2 Stator motor assy.           | 8 Receptacle connector      | 14 Overload protector    |
| 3 Ball bearing (2 rqr)         | 9 Screw machine             | 15 Retaining plate       |
| 4 Motor fan (2 rqr)            | 10 Overload protector cover | 16 Washer flat           |
| 5 Grooved pin (2 rqr)          | 11 Screw, machine           | 17 Screw, machine        |
| 6 Rotor                        | 12 Housing mouting endbell  |                          |

Figure 5-2. Blower motor, disassembly and reassembly (Model CE20VAL4).

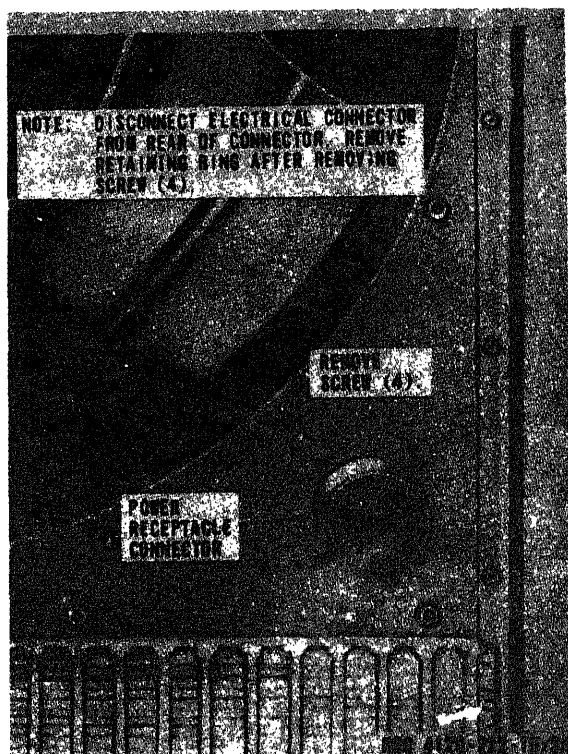


Figure 5-3. Power receptacle connector removal and installation.

*b. Removal.* Remove outdoor thermostat as illustrated on figure 5-5.

*c. Testing.* Test the thermostat for continuity with a multimeter set on OHMS. Refer to the wiring diagram for the points to establish continuity.

*d. Installation.* Replace defective thermostat and install in reverse order of removal as illustrated in figure 5-5.

### 5-8. Electrical Heater Thermostat

*a. Testing.* Tag and disconnect the leads and test the electrical heater thermostat for continuity with a multimeter set on OHMS. Refer to the wiring diagram for the points to establish continuity.

*b. Removal.* Refer to figure 5-6, and remove the electrical heater thermostat.

*c. Installation.* Replace a defective thermostat and make sure all electrical connections are clean and secure. Refer to figure 5-6, and install the electrical heater thermostat in reverse order of removal as illustrated.

### 5-9. Control Box and Control Panel

*a. General.* The control panel houses the selector switch and temperature control and is mounted on

the control box. The selector switch is a manually operated, five-position switch. Automatic control of both the heating and cooling cycles is provided by the temperature control. The control panel may be used in a remote position by utilizing a block off plate and a remote control cable (fig. 2-1).

*b. Removal.* Refer to figure 5-7, and remove the control box front panel and control panel.

*c. Disassembly.* Refer to figure 5-8, and disassemble the control panel.

*d. Reassembly.* Replace defective parts and reassemble the control panel in reverse order of removal as illustrated on figure 5-8.

*e. Installation.* Install the control panel and control box front panel in reverse order of removal as illustrated on figure 5-7.

### 5-10. Tubing and Fittings

The refrigerant tubes used on the air conditioner consist of copper tubing and the necessary fittings. The joints of the refrigerant tubes are soldered. Inspect the tubing for cracks and breaks. Replace any defective tubing with tubes of the same length, size, shape, and material. When removing and installing the solenoid valves, direct the flame away from the valve body to protect it from heat damage. Keep the flame at the outside of the distributor when disassembling or reassembling the expansion valve. Test the installation of tubes and fittings for leaks. Replace rubber insulation as necessary.

*Note.* If the refrigerant system has been open to the atmosphere, replace the dehydrator. Pressure test and evacuate the system before charging. When removing tubing, pass dry nitrogen through lines when soldering for prevention of copper oxides.

### 5-11. Phase Sequence Relay

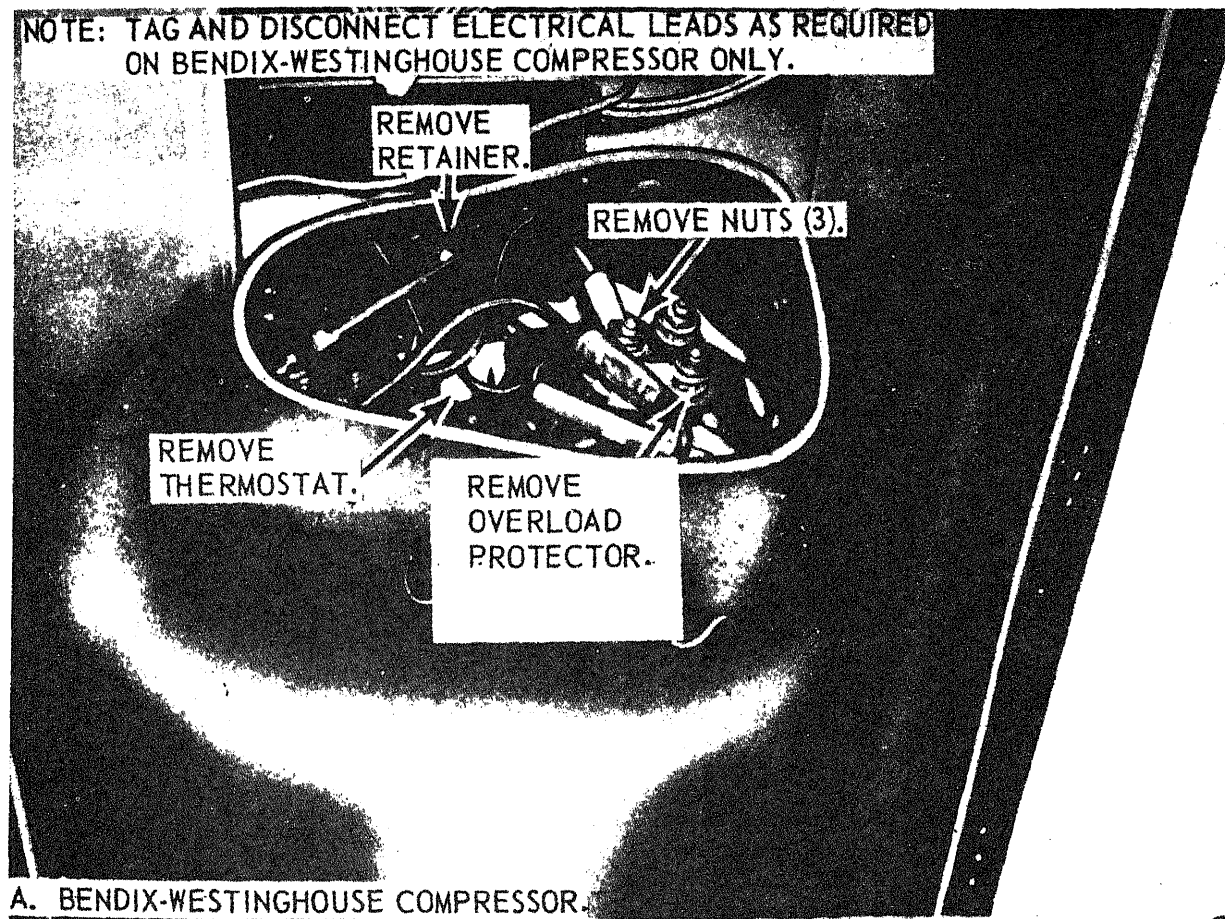
*a. General.* The phase sequence relay is used when the air conditioner has a Whirlpool compressor. It is not required when the unit has a Bendix-Westinghouse Compressor. The phase sequence relay prevents operation of the unit unless the phase sequence is correct and the fan and compressor motor rotate in the proper direction. It is located in the upper left corner of the control box.

*b. Removal.* Refer to figure 5-9, and remove phase sequence relay.

*c. Installation.* Replace a defective phase sequence relay. Install the phase sequence relay in reverse order of removal as illustrated on figure 5-9.

*d. Test.* Test phase sequence relay by referring to wiring diagram and checking for continuity or open circuit across the normally closed or normally open contacts. Also test the relay solenoid for continuity.

NOTE: TAG AND DISCONNECT ELECTRICAL LEADS AS REQUIRED ON BENDIX-WESTINGHOUSE COMPRESSOR ONLY.



A. BENDIX-WESTINGHOUSE COMPRESSOR.

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Figure 5-4. Compressor overload protector and heater thermostat removal and wiring. (Sheet 1 of 2)

## 5-12. Circuit Breaker

a. *General.* Some of the earlier model CE20VAL6 air conditioner do not have circuit breaker. The circuit breaker protects the compressor from continuous overcurrent and short circuits. It is located in the lower right corner of the control box. Refer to paragraph 2-9 for reset procedure.

b. *Testing.* Refer to figure 5-9, tag and disconnect the leads and test the circuit breaker for continuity with a multimeter set on OHMS. Refer to the wiring diagram for points to establish continuity.

### c. Removal.

(1) Refer to figure 5-9 (1), and remove the circuit breaker.

(2) Refer to figure 5-9 (2), and disconnect the circuit breaker linkage as follows:

(a) Remove snap ring (1) from pin (4).

(b) Pull pin (4) and spacer (3) from switch arm (2).

(c) Remove linkage rod (6) and connector (5).

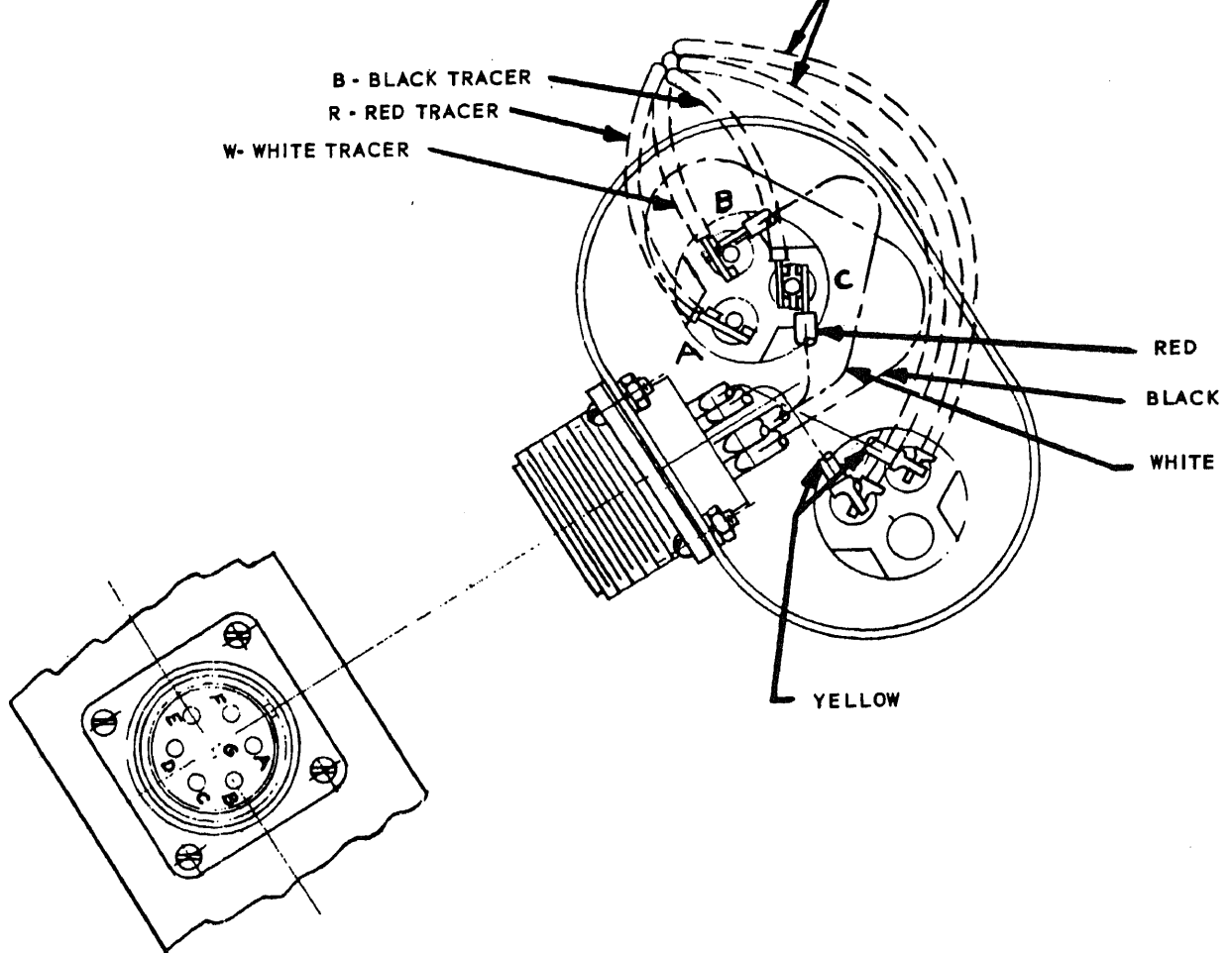
d. *Installation.* Replace a defective circuit breaker in reverse order of removal as illustrated on figure 5-9.

## 5-13. Rectifier

a. *General.* New models of CE20VAL6 and CE20VAL4 air conditioners have a solid state rectifier, figure 5-9. The earlier models have a rectifier and a surge suppressor. Both are located in the control box at the upper right corner and are removed in a similar manner. The rectifier changes alternating current to direct current.

b. *Testing.* Disconnect the electrical leads. Use a multimeter and test the front to back resistance of the rectifier. A resistance of infinity in both directions indicates an open rectifier. Replace a defective rectifier or surge compressor.

c. *Removal.* Refer to figure 5-9, and remove the rectifier.



ATTACH CONNECTOR LEADS  
TO THE FOLLOWING:

TERMINAL	LEAD	COLOR
A	PHASE A	BLACK
B	PHASE B	WHITE
C	PHASE C	RED
D	THERMOSTAT	YELLOW
E	THERMOSTAT	YELLOW
F	OPEN NC	
G	OPEN NC	

B. WHIRLPOOL COMPRESSOR

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*Figure 5-4. Compressor overload protector and heater thermostat removal and wiring. (Sheet 2 of 2).*

*d. Installation.* Replace a defective rectifier in reverse order of removal as illustrated on figure 5-9.

#### 5-14. Terminal Blocks

*a. General.* There are three terminal blocks on model CE20VAL6 and only two on model CE20VAL4. They are all mounted in the control

box. Power is distributed from these terminal blocks to all electrical components of the air conditioner. All terminal blocks are removed and installed in a similar manner.

*b. Removal.* Remove terminal blocks as illustrated on figure 5-9.

*c. Installation.* Replace defective terminal blocks

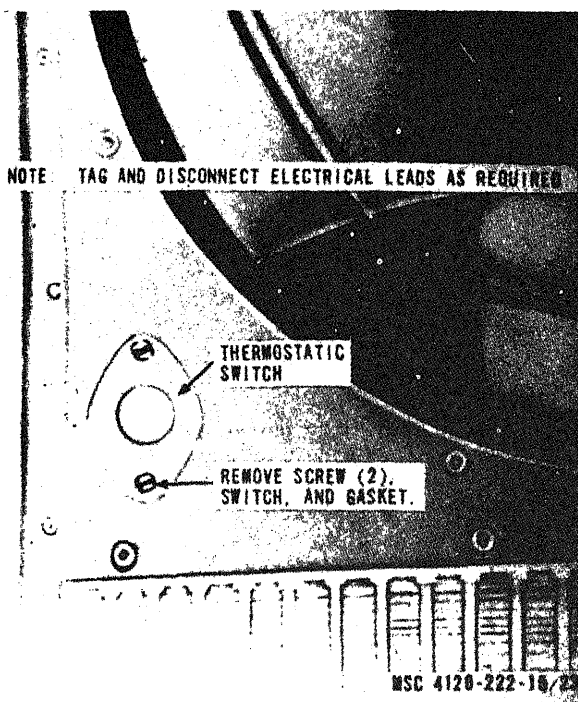


Figure 5-5. Outdoor thermostat removal and installation.

and install in reverse order of removal as illustrated on figure 5-9.

*d. Inspection.* Inspect terminal blocks for cracks, breaks, or other damage.

### 5-15. Compressor Motor Contactor and Electrical Heater Contactor

*a. General.* Both contactors are located in the control box, figure 5-9. A motor contactor starts the compressor motor and a heater contactor is connected to the electrical heaters.

*b. Removal.* Remove contactors as illustrated on figure 5-9.

*c. Installation.* Replace defective contactors and install in reverse order of removal as illustrated on figure 5-9.

### 5-16. Control Box and Receptacles

*a. Removal.* Refer to figure 5-9, and remove the control box and receptacles.

*b. Installation.* Replace defective control box and receptacles and install in reverse order of removal as illustrated on figure 5-9.

**Caution:** Do not remove control box until the circuit breaker linkage is disconnected.

### 5-17. Electric Heater Elements

*a. General.* The two banks of electrical resistance heaters are mounted directly behind the

evaporator coil. These heaters provide the heat called for by the temperature control to maintain the required temperature of the conditioned air. The two banks of heaters provide two ranges of heating and are manually controlled by placing the selector switch in the proper position (LO-HEAT or HI-HEAT) to maintain the required temperature.

*b. Inspection.* Inspect elements for breaks, cracks, or other damage.

*c. Removal.* Remove electric heater elements as illustrated in figure 5-10.

*d. Installation.* Replace a defective heater and install in reverse order of removal as illustrated in figure 5-10.

### 5-18. Back Pressure Regulating Valve

*a. General.* Back pressure regulating valve figure 5-10 regulates refrigerant pressure in the evaporator to prevent coil freeze up. Valve is preset to establish a minimum pressure in the evaporator of 57.8 psig.

*b. Adjusting.* Adjust the back pressure regulating valve by loosening the lock nut at the top of the valve and turning the adjusting screw. Tighten the lock nut after adjustment.

*c. Removal.* Refer to figure 5-10, and remove the back pressure regulator valve.

*Note.* Discharge the refrigerant before removing back pressure valve.

*d. Installation.* Replace a defective back pressure regulating valve and install in reversing order of removal as illustrated on figure 5-10. Evacuate, and recharge refrigerant system (para 5-33).

### 5-19. Wiring Harness and Wire Leads

*a. General.* The electrical circuits in the air conditioner are completed by individual wire leads or by wire leads laced or enclosed in a loom to form a wiring harness. All of the wiring carries code numbers. When testing, repairing or replacing the wiring harness or individual wires, refer to the practical wiring diagrams, figures 1-4. Inspect all wiring installations for cracked or frayed insulation material. Pay particular attention to the wires passing through holes in the frame or around sharp edges. Repair or replace defective wiring.

*b. Testing.* Test for continuity by disconnecting each end. Touch the test probes of a multimeter to each end of wire. If continuity is not indicated, repair or replace wire.



NOTE: TAG AND DISCONNECT ELECTRICAL LEADS AS REQUIRED

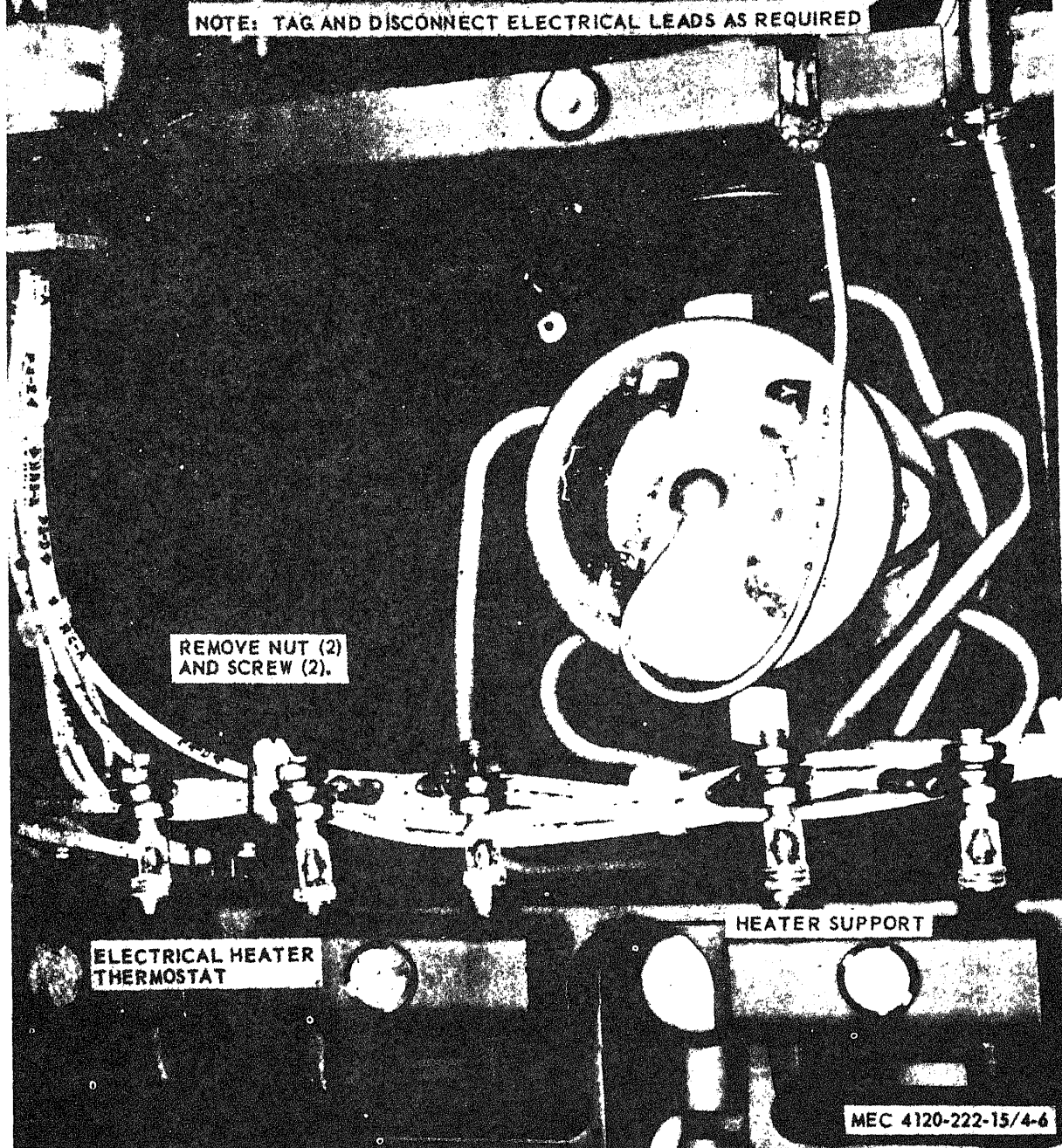


Figure 5-6. Electrical heater thermostat removal and installation.

c. *Repair.* Remove insulation to expose  $\frac{1}{2}$  inch of bare wire on each side of break. Twist the wire ends together and solder the connection. Cover the connection with electrical tape and friction tape making certain to cover all the exposed area. Replace broken terminal lugs with exact duplicates.

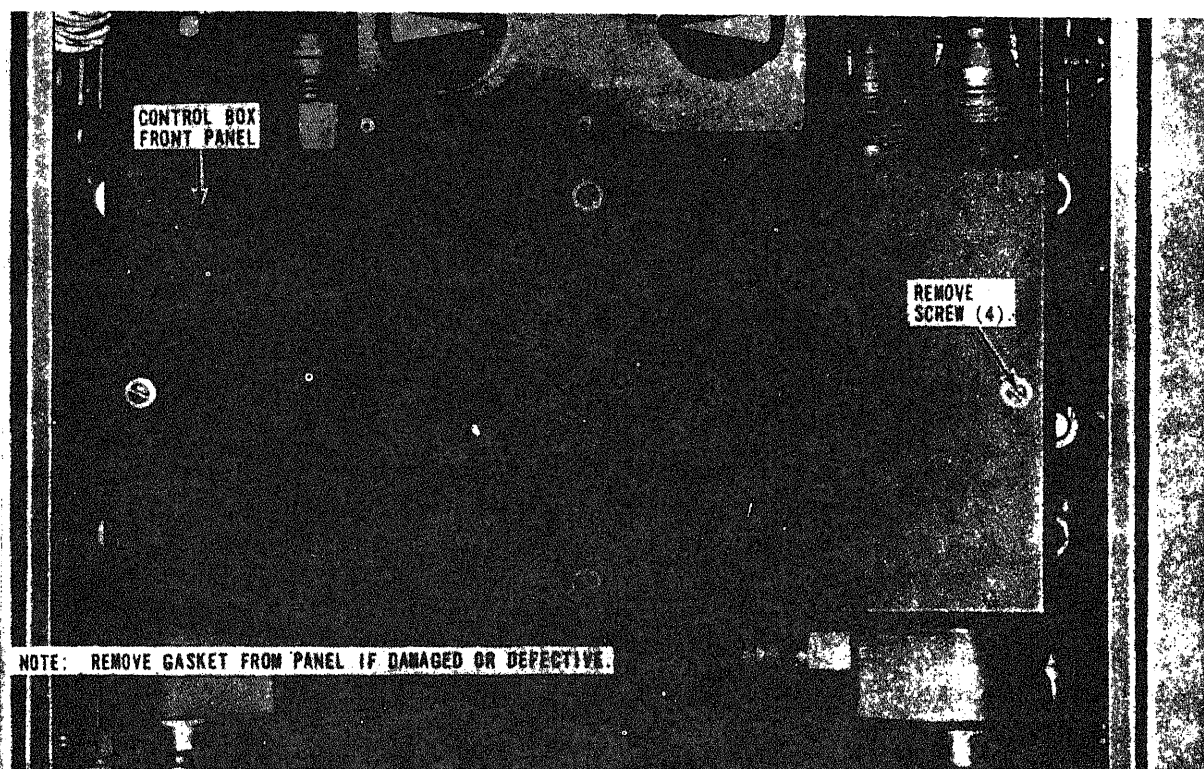
d. *Replacement.* Replace single wire by using exact duplicates of terminal lugs from old wire. If the wire is part of a harness assembly, disconnect the wire at both ends and cap ends. Attach the replacement wire to the outside of the harness

with electrical tape. Refer to figure 1-4 for practical wiring diagrams.

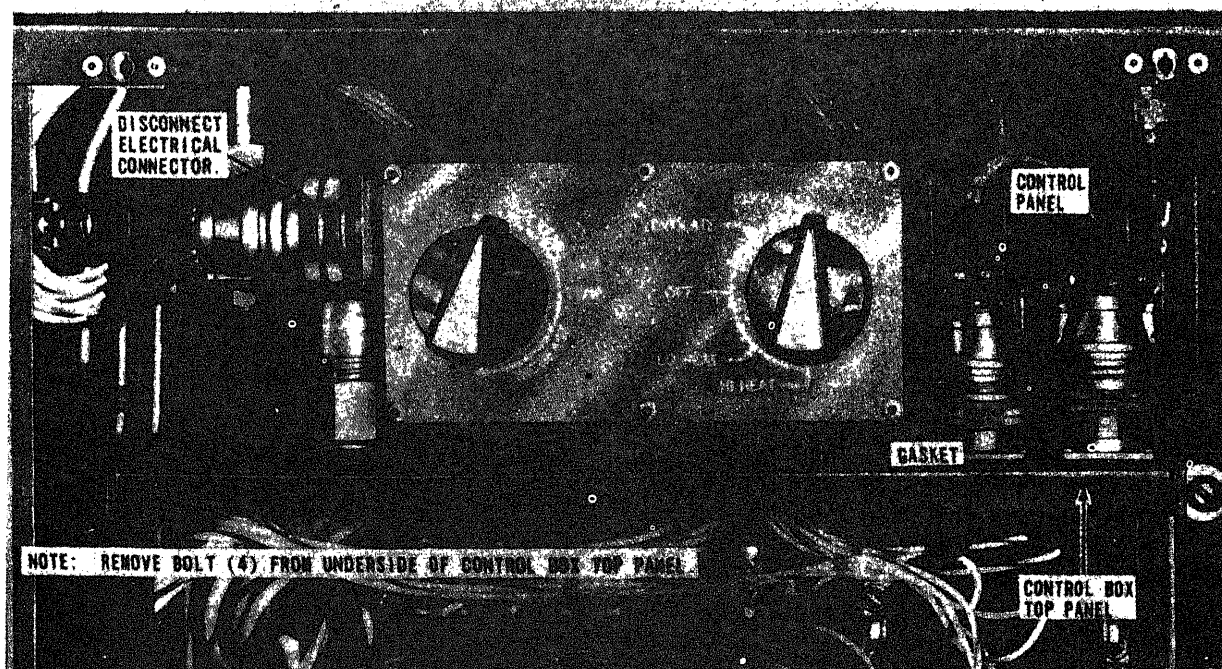
## 5-20. Service Valves

a. *General.* The two angle type service valves (suction tube and discharge tube) provide access to the refrigerant system.

b. *Removal.* Discharge the refrigerant system and refer to figure 5-11 and remove the service valves.



A. CONTROL BOX FRONT PANEL



B. CONTROL PANEL

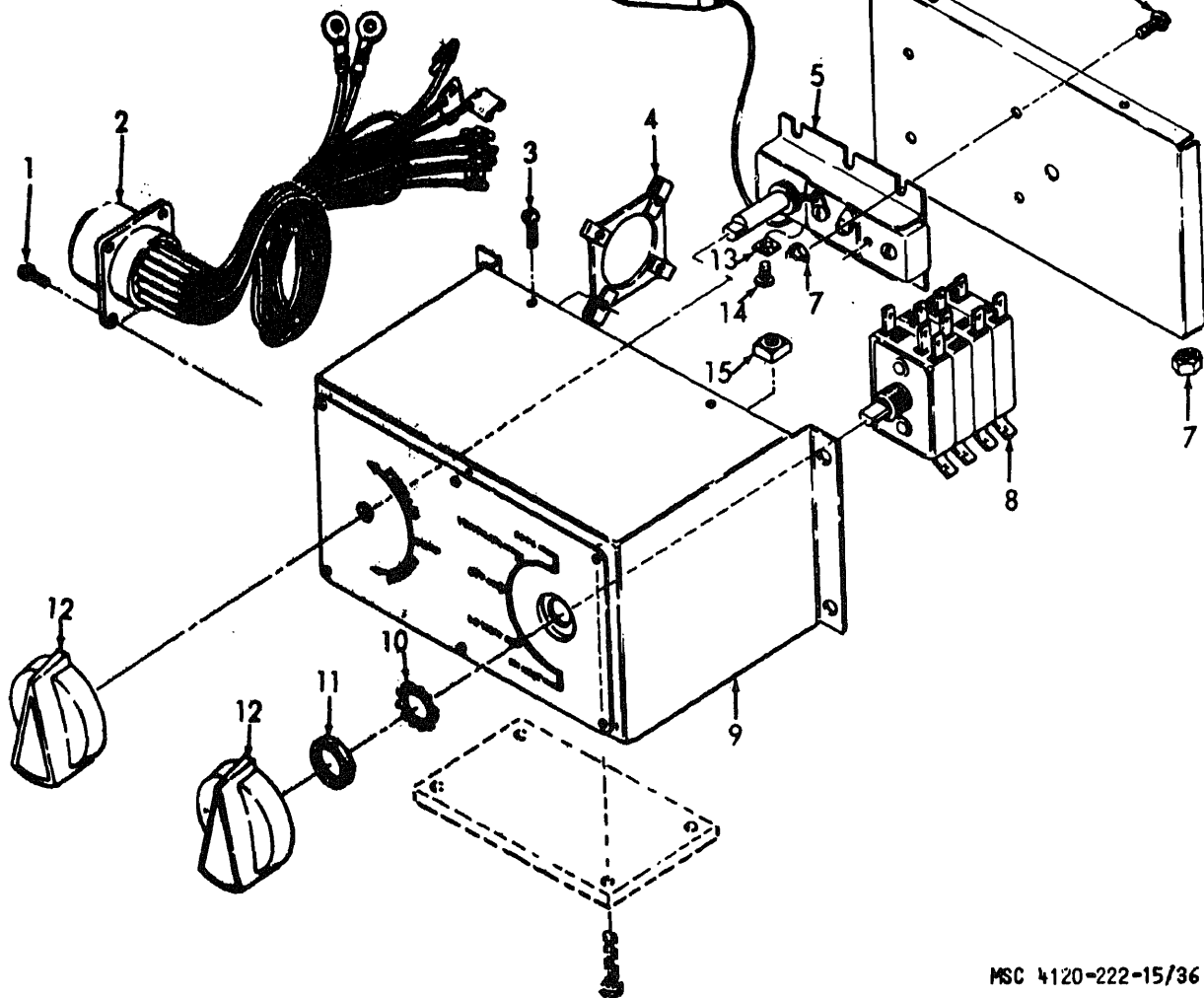
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Figure 5-7. Control box front panel and control panel removal and installation.

c. *Installation.* Replace a defective valve and install valves in reverse order of removal. Evacuate and recharge the unit refrigeration system (para 5-38).

## 5-21. Thermostatic Expansion Valves

a. *General.* A 1-ton thermostatic expansion valve controls the rate of flow of liquid refrigerant into the evaporator coil during the cooling cycle of



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- 1 Screw, machine, rd-hd forming No. 4 X  $\frac{1}{2}$  in. (4 rqr)
- 2 Receptable connector
- 3 Screw, machine rd-hd, No. 3-32 X  $\frac{1}{2}$  in. (8 rqr)
- 4 Retaining ring
- 5 Temperature control (temperature control thermostat)
- 6 Control panel plate

- 7 Nut, hex, No. 8-32 (8 rqr)
- 8 Selector switch
- 9 Control panel casing
- 10 Washer, lock IT (spec)
- 11 Nut, hex (spec)
- 12 Knob (2 rqr)
- 13 Tube clip
- 14 Screw, machine, No. 6-32 X  $\frac{1}{4}$  in.
- 15 Nut, retainer, No. 10-32 (4 rqr)

*Figure 5-8. Control panel, disassembly and reassembly.*

operation. The one-half ton thermostatic expansion valve functions when the unit is in the bypass cycle of operation. Each expansion valve is provided with a super heat setting adjustment ( $10^{\circ}\text{F}$ . for each model) to assure efficiency in the refrigerant system.

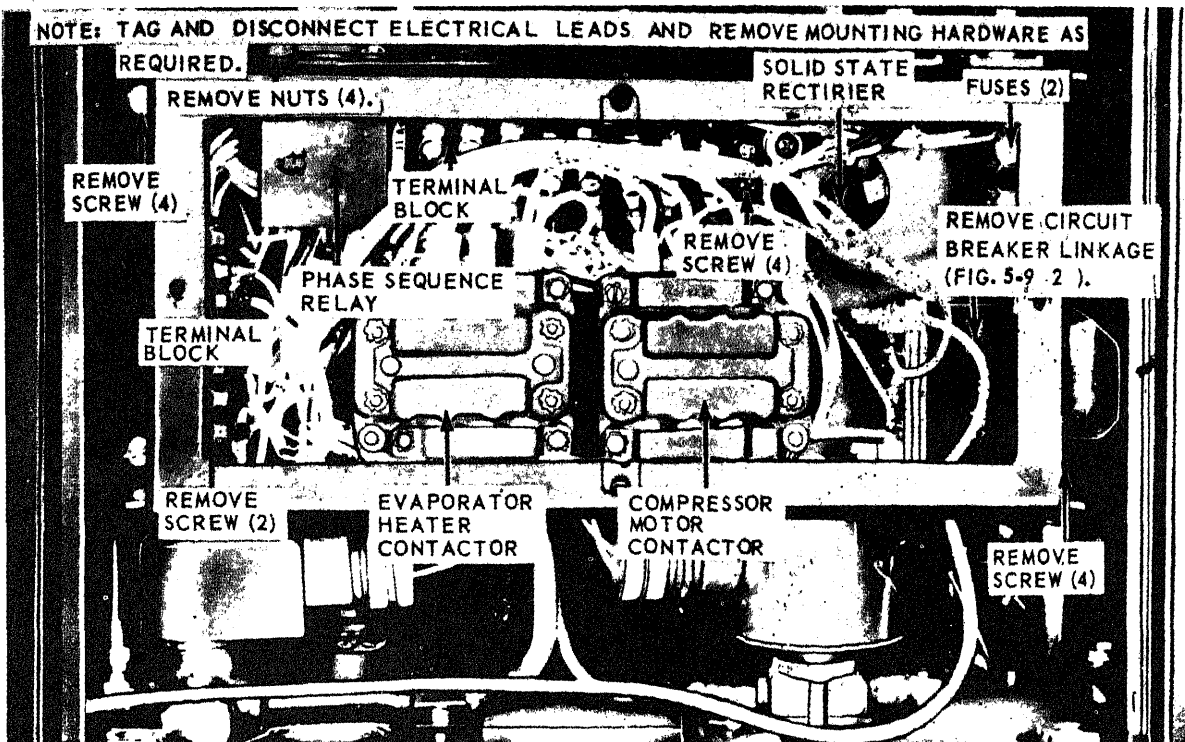
**b. Removal.** Discharge the refrigerant system, refer to figure 5-12, and remove the thermostatic expansion valves.

**c. Adjustment.** Refer to figures 5-13 and 5-14, and check and adjust the superheat setting of the 1-ton thermostatic expansion valve. The  $\frac{1}{2}$ -ton

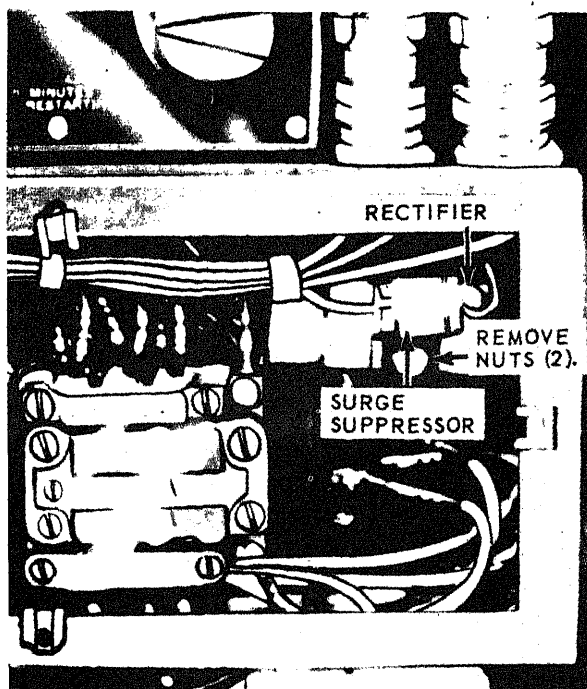
thermostatic expansion valve adjusts in the same manner.

**d. Installation.** Replace defective expansion valves and install in reverse order of removal as illustrated in figure 5-12. Evacuate and recharge the unit refrigerating system (para 5-33).

*Note.* A gas is superheated whenever its temperature is higher than the temperature corresponding to its pressure at saturation. Example: Refrigerant -22 at 69 pounds pressure has a temperature of  $40^{\circ}\text{F}$ . If the suction pressure gage reads 69 pounds and the temperature of the suction tube reads  $50^{\circ}\text{F}$ ., the gas is superheated  $10^{\circ}\text{F}$ .



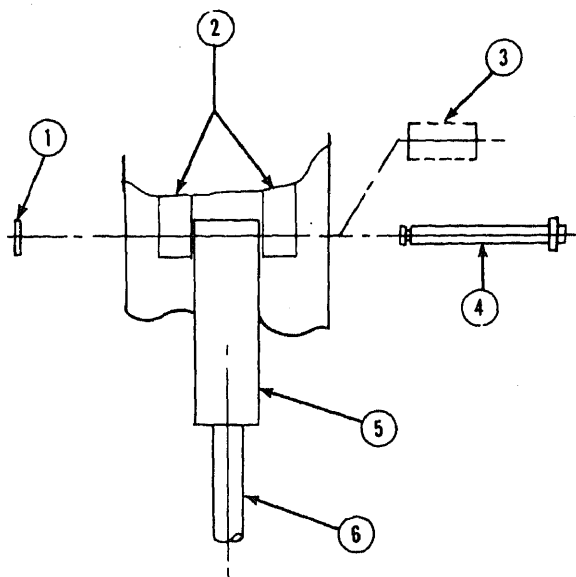
A. CONTROL BOX WITH SOLID STATE RECTIFIER



B. CONTROL BOX WITH SURGE SUPPRESSOR AND RECTIFIER.

ME 4120-222-14'S-9 (1)

Figure 5-9. Phase sequence relay, circuit breaker, rectifier, terminal blocks, contactors, receptacle connectors, and control box, removal and installation, Model CE20VAL4 (Sheet 1 of 2).



C. CIRCUIT BREAKER LINKAGE

MEC 4120-222-15/4-9 (2)

- |                   |                     |
|-------------------|---------------------|
| 1 Snap ring       | 4 Pin               |
| 2 Switch arms     | 5 Linkage connector |
| 3 Phenolic spacer | 6 Linkage rod       |

Figure 5-9—Continued. (Sheet 2 of 2).

## 5-22. High Pressure Cutout Switch

*a. General.* Some of the earlier model CE20VAL6 and CE20VAL4 air conditioners do not have a high pressure cutout switch. The high pressure cutout switch prevents the compressor from operating if the head pressure exceeds 445 psig (pounds per square inch gage).

*b. Removal.* Discharge the refrigerant system and remove high pressure cutout switch as illustrated in figure 5-15.

*c. Testing.* Test the pressure switch for continuity with a multimeter set on OHMS. Press the reset button and recheck. Refer to the wiring diagram for the points to establish continuity.

*d. Installation.* Replace a defective high pressure cutout switch in reverse order of removal as illustrated in figure 5-15. Evacuate and recharge the unit refrigerant system (para 5-33).

## 5-23. Hot Gas Bypass Solenoid Valve

*a. General.* Solenoid valves are automatically actuated by the temperature control and control the flow of refrigerant through the system.

*b. On-Equipment Testing.* Start the air conditioner. In the bypass mode of operation the tubing from the discharge side of valve should become warm immediately. If not, stop the unit and check the electrical connection and solenoid valve coil. If the valve fails to click upon start of the by-pass

mode of operation, stop the unit and check the electrical connection and coil. Refer to figure 5-15 and disconnect the electrical connector. Test the solenoid valve coil for continuity with a multimeter set on OHMS. Continuity should exist between the coil leads. Connect one lead of the multimeter to the air conditioner casing and touch the other lead to either of the coil leads. Continuity should not exist.

*c. Removal and Disassembly.* Discharge the refrigerant system, refer to figure 5-15 and 5-16, and remove and disassemble the hot gas bypass solenoid valve.

**Caution:** The hot gas bypass solenoid valve must be disassembled before disconnecting the tubing from the valve to avoid heat distortion.

*d. Reassembly and Installation.* Replace any defective parts. Reassemble and install in reverse order of removal as illustrated on figures 5-15 and 5-16. Evacuate and recharge the unit refrigerating system (para 5-33).

**Caution:** Solder the tubing to the valve before reassembling the valve to avoid heat distortion.

## 5-24. Liquid Line Solenoid Valve and Liquid Line Bypass Solenoid Valve

*a. On-Equipment Testing.* Start the air conditioner. If the solenoid valves fail to click upon start of operation, stop the unit and check the electrical connection and coils. Test the solenoid valve coils in the same manner as the hot gas bypass solenoid valve coil (para 5-23).

*b. Removal and Disassembly.* Refer to figures 5-17 and 5-18, and remove and disassemble the liquid line solenoid valve and liquid line bypass solenoid valve.

**Caution:** The solenoid valves must be disassembled before disconnecting the tubing from the valve to avoid heat distortion.

*c. Reassembly and Installation.* Pressure test, evacuate and recharge the refrigerant system (para 5-33).

**Caution:** Solder the tubing to the valves before reassembling the valves to avoid heat distortion.

## 5-25. Dehydrator

*a. General.* The dehydrator prevents the accumulation of moisture and contaminants within the refrigerant tubing. The dehydrator must be replaced each time the system is exposed to the atmosphere.

*b. Removal.* Refer to figure 5-19, and remove the dehydrator.



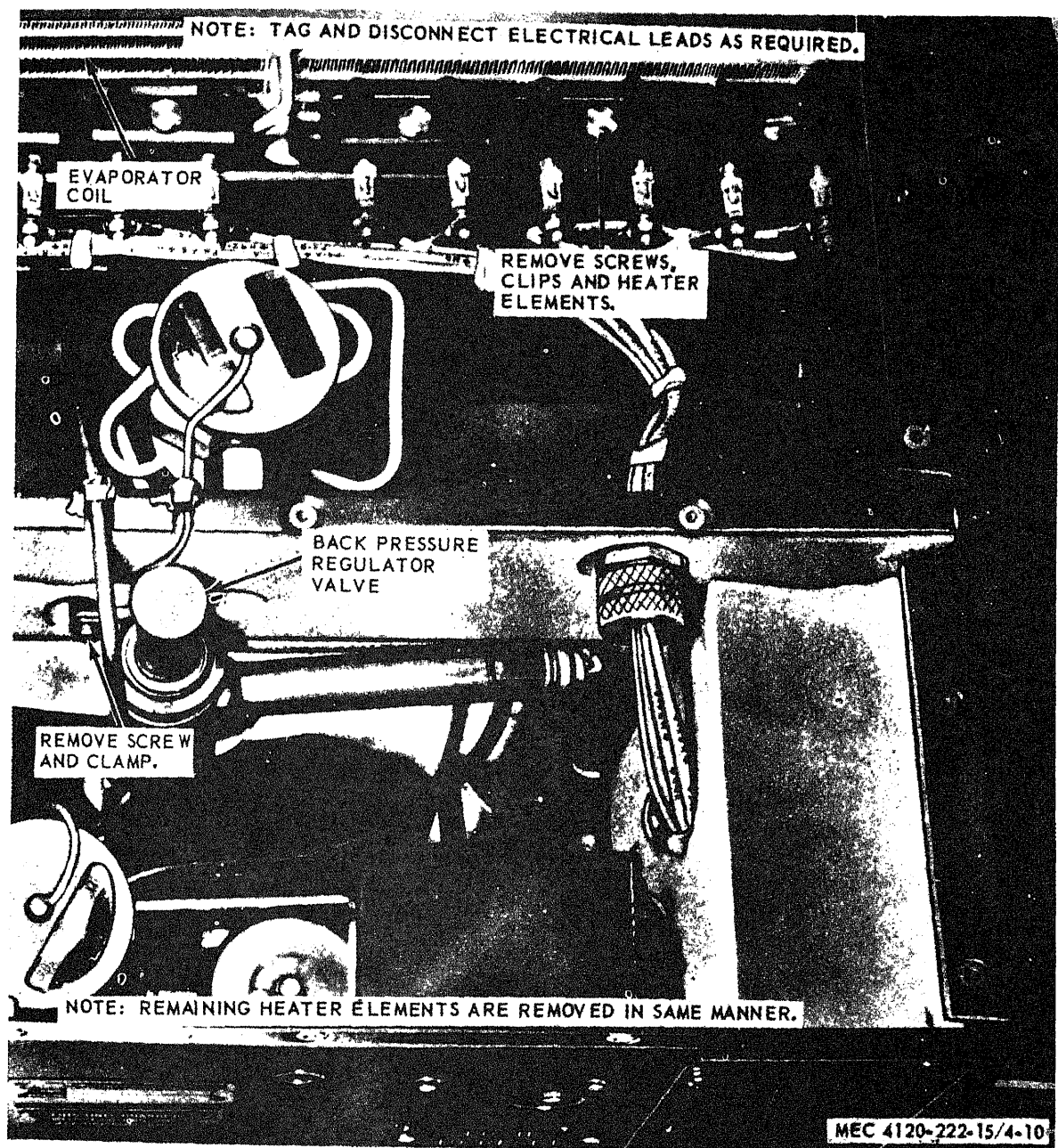


Figure 5-10. Electric heater elements and back pressure regulating valve removed and installation.

c. *Installation.* Install a new dehydrator by reversing removal order as illustrated on figure 5-19. Evacuate and recharge the unit refrigerating system (para 5-33).

## 5-26. Pressure Relief Valve

a. *General.* Pressure relief valve (fig. 5-19) is located on a tee just below the dehydrator. The pressure relief valve protects the refrigerant system from excessive pressure.

b. *Removal.* Discharge the refrigerant system, refer to figure 5-19, and remove the pressure relief valve.

c. *Installation.* Replace a defective pressure relief valve by reversing order of removal as illustrated on figure 5-19. Pressure test, evacuate and recharge refrigerating system (para 5-33).

## 5-27. Sight Glass

a. *General.* The sight glass indicates the refrigerant moisture content. A shortage of refrigerant is indicated by bubbles in sight glass.

b. *Inspection.* Inspect sight glass for cracks, breaks, or other damage.

c. *Removal.* Remove top panel, air conditioner.

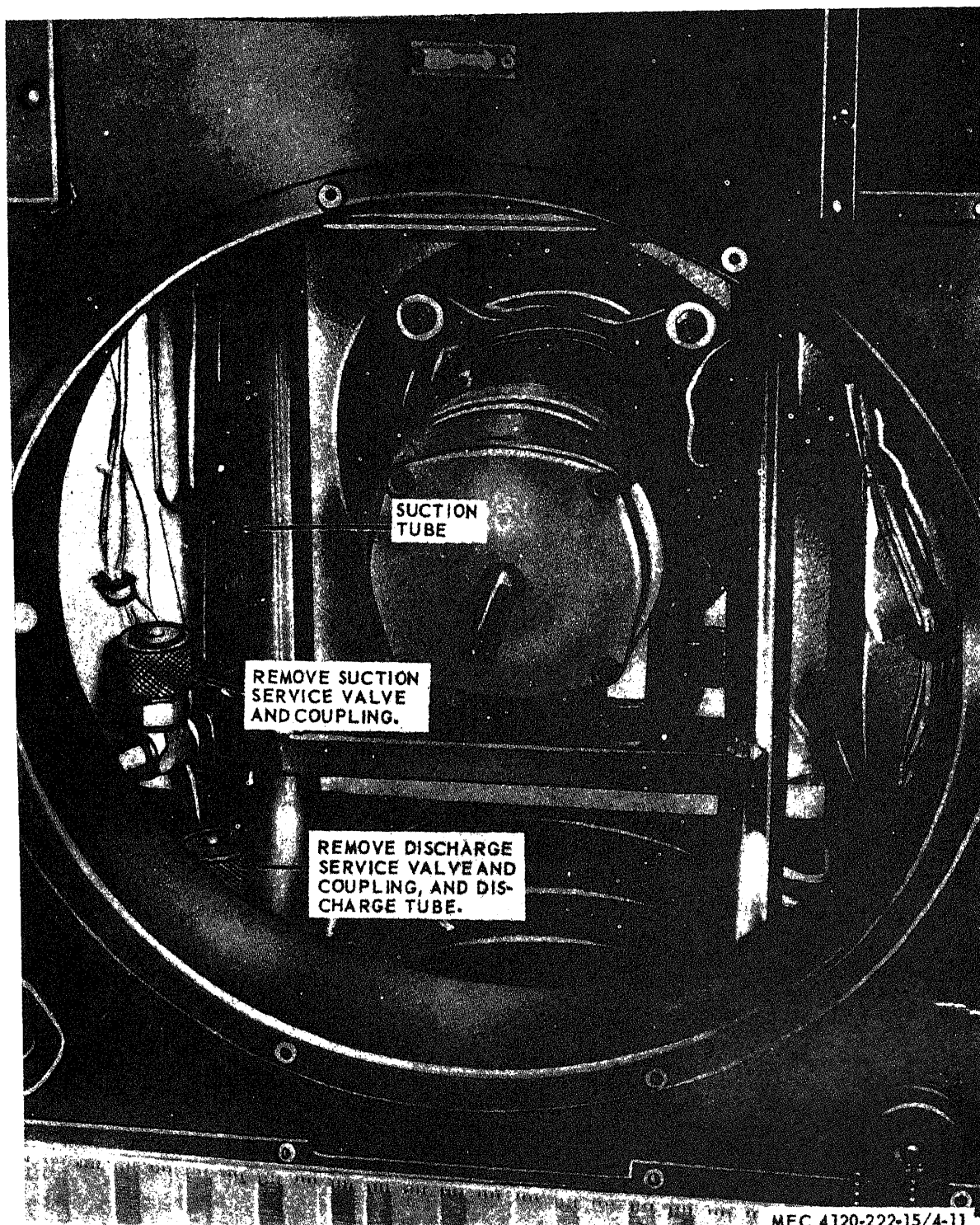


Figure 5-11. Service valves, removal and installation.

Remove the two screws holding the bracket, unsolder the sight glass connections and remove (fig. 5-20).

*d. Installation.* Place a new liquid line sight glass in position and solder connections. Since the replacement glass opened the refrigerant system the system must be completely evacuated and then

fully charged. See figure 5-26 for instructions on evacuation and charging system.

## 5-28. Evaporator Coil

*a. General.* The evaporator coil is mounted on the casing, directly behind the discharge grill and mist eliminator. The coil must be removed from

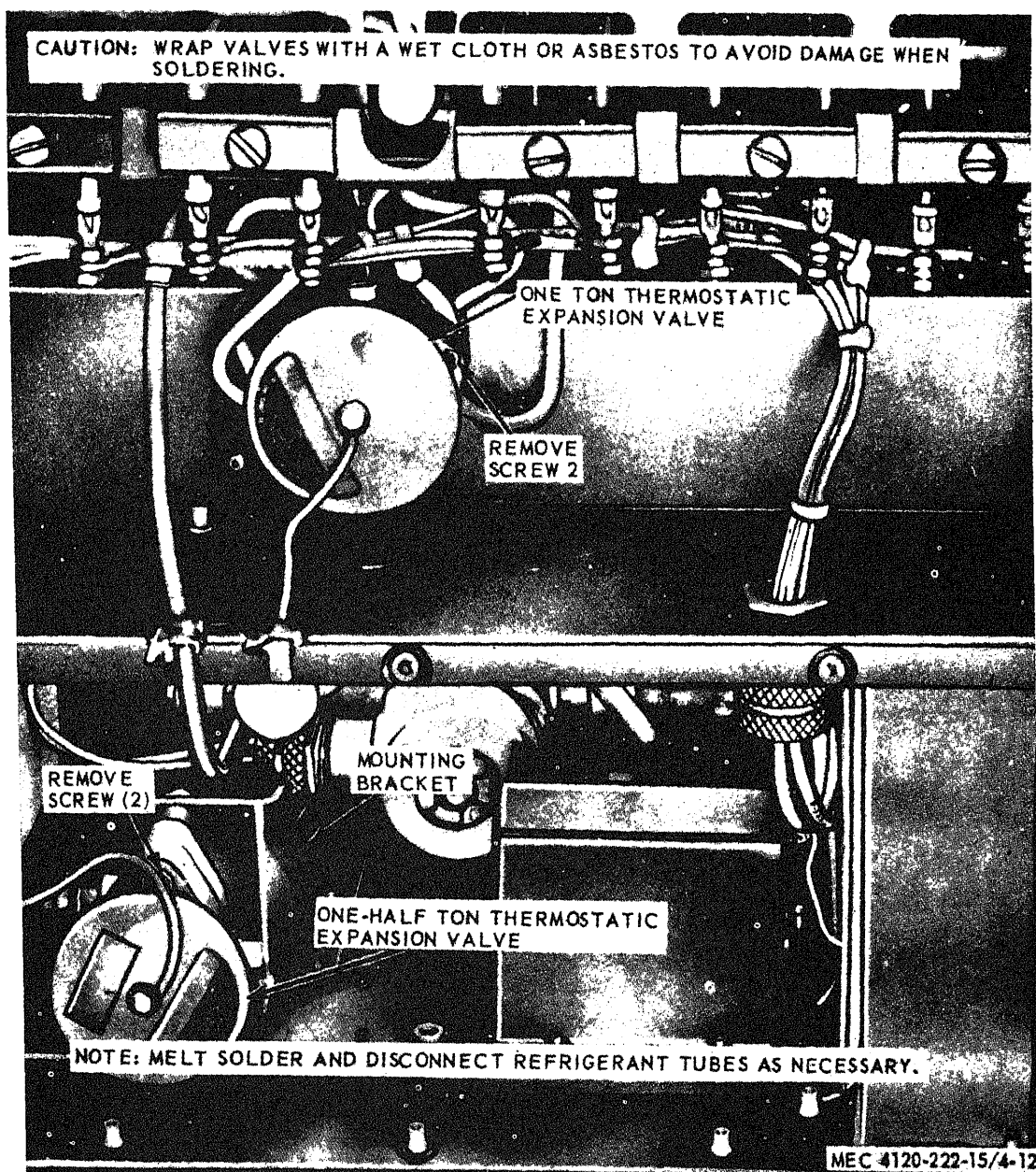


Figure 5-12. Thermostatic expansion valves removal and installation.

the air conditioner for repair or replacement. The coil is made of aluminum and is of the plate-fin configuration.

**b. Removal.** Refer to figure 5-21, and remove evaporator coil.

**c. Cleaning, Inspection and Repair.** Use a wire brush and brush off evaporator coil; blow dirt out with compressed air. Wipe with cloth dampened with an approved cleaning solvent. Inspect coil for bent fins, damaged coil runs and interval leaks. Straighten bent fins with needle nose pliers. A damaged coil or an internally leaking coil cannot be repaired.

**d. Installation.** Replace a defective coil assembly and install in reverse order of removal as illustrated in figure 5-21. Evacuate and recharge refrigerating system (para 5-33).

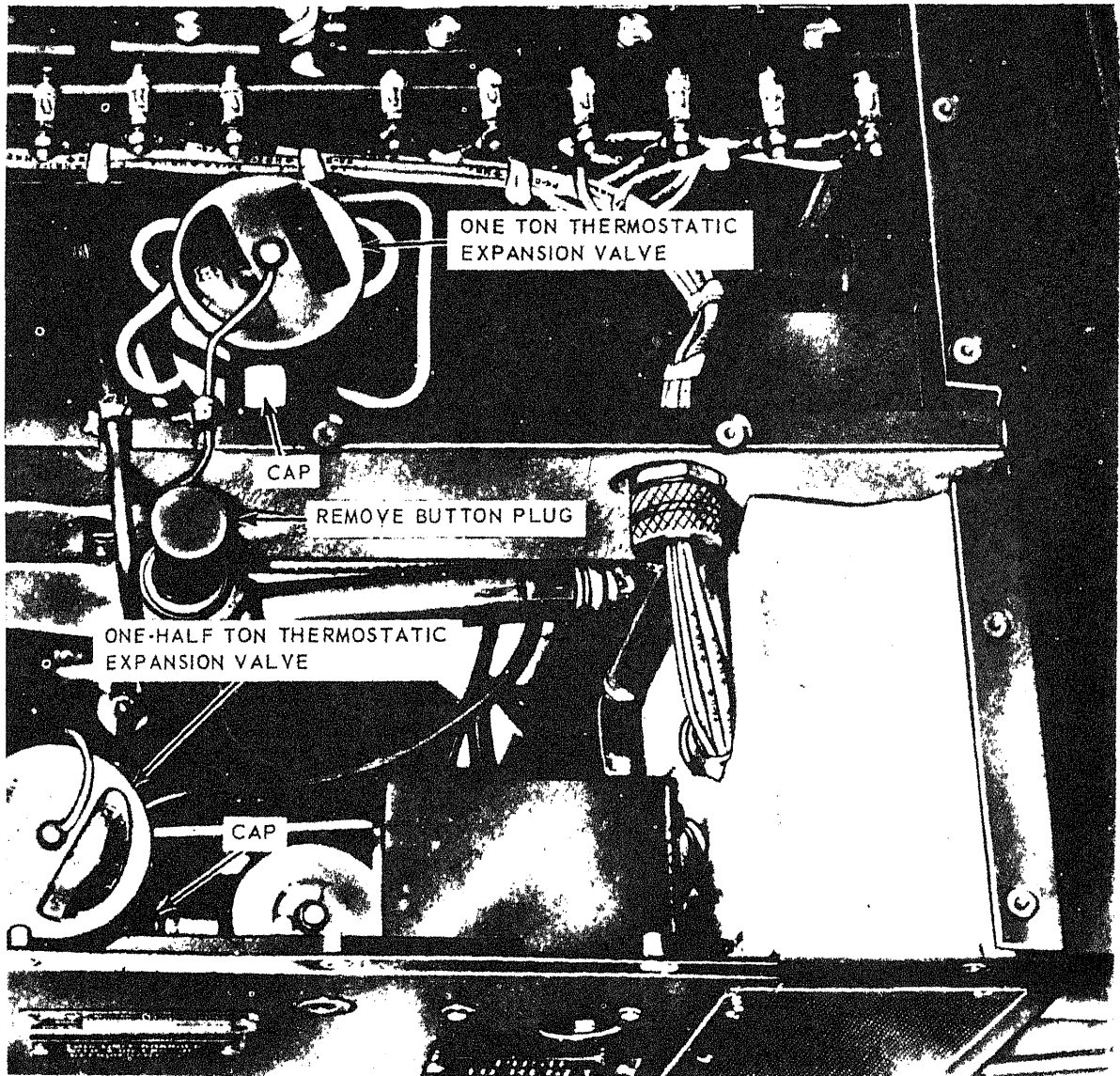
### 5-29. Condenser Coil

**a. General.** The condenser coil is mounted on the bottom rear of the casing, directly beneath the condenser fan. The coil must be removed from the air conditioner for repair or replacement. The coil is made from aluminum and is of the plate-fin configuration.

**b. Removal.** Refer to figure 5-22, and remove condenser coil.



CAUTION: NEVER ADJUST THE EXPANSION VALVE UNLESS IT IS ABSOLUTELY NECESSARY. WHEN ADJUSTING THE EXPANSION VALVE, ALLOW AT LEAST 20 MINUTES BETWEEN EACH ADJUSTMENT. THIS TIME ELEMENT IS VERY IMPORTANT AND MUST BE OBSERVED.

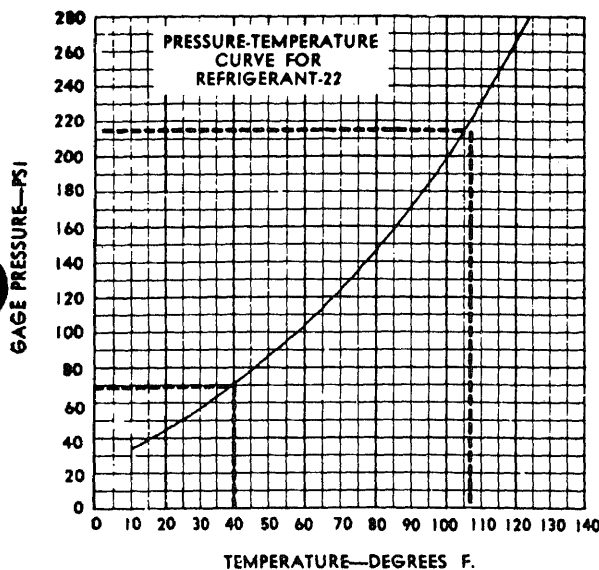


ADJUSTMENT:

- STEP 1. TAPE THE BULB OF A THERMOMETER TO SUCTION TUBE NEAR SENSING ELEMENT. INSULATE THERMOMETER BULB.
- STEP 2. INSTALL A SUITABLE PRESSURE GAGE AT SUCTION TUBE SERVICE VALVE (PAR. 5-20).
- STEP 3. OPERATE THE UNIT (PAR. 2-11) FOR APPROXIMATELY 30 MINUTES (THERMOMETER READING MUST STABILIZE).
- STEP 4. CHECK THERMOMETER AND PRESSURE GAGE READINGS. COMPARE READINGS WITH FIGURE 5-14 THERMOMETER READING SHOULD BE APPROXIMATELY 10 F HIGHER THAN TEMPERATURE GIVEN ON FIGURE.
- STEP 5. REMOVE BUTTON PLUG (SHOWN ABOVE). REMOVE CAP AND TURN ADJUSTING SCREW ONE TURN CLOCKWISE TO INCREASE SUPERHEAT 4 F. OR ONE TURN COUNTERCLOCKWISE TO DECREASE SUPERHEAT. INSTALL CAP. INSTALL BUTTON PLUG.

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*Figure 5-13. One-ton thermostatic expansion valve, adjustment.*



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Figure 5-14. Pressure-temperature curve for refrigerant -22.

*c. Cleaning, Inspection, and Repair.* Refer to paragraph 5-28 and clean and inspect the condenser coil in a similar manner.

*d. Installation.* Replace a defective coil assembly and install in reverse order of removal as illustrated in figure 5-22. Evacuate and recharge refrigerating system (para 5-33).

### 5-30. Compressor and Motor Assembly

*a. General.* The sole purpose of the compressor is to raise the pressure of refrigerant gas from evaporator pressure to condensing pressure. The function of the compressor is to deliver refrigerant to the condenser at a pressure and temperature at which the condensing process can readily be accomplished. The motor/compressor is a hermetically sealed unit and is not repairable in the field. An inoperative compressor is usually due to a mechanical failure causing the compressor to freeze, control failure, or a motor burnout. If the motor/compressor is mechanically frozen or there has been a motor burnout, the compressor must be removed and replaced. When the motor of a hermetic compressor fails, high temperatures may develop within the compressor causing a breakdown of the oil and refrigerant, resulting in formation of acid, moisture, and sludge. All these are extremely corrosive and must be flushed from the system. Repeated burnouts will occur if all of the contaminants are not removed.

*b. Cleaning and Inspection.* The immediate area around the compressor mounting should be thoroughly cleaned with a suitable solvent and dried.

Examine all connections for foreign matter of any kind. Inspect area thoroughly.

**Warning:** Avoid bodily contact with the refrigerant, especially eye contact. Avoid inhalation of refrigerant fumes.

*c. Removal.* Discharge the refrigerant system, refer to figure 5-23, and remove the compressor.

*d. Installation.* Install a replacement compressor in reverse order of removal, as illustrated in figure 5-23. Pressure test, evacuate and recharge refrigerating system (para 5-33).

### 5-31. Compressor Heater and Oil Level Plug (Bendix-Westinghouse)

*a. General.* The heater is to prevent refrigerant sludging. The compressor heater is controlled by the compressor heater thermostat. It provides heat to prevent sludging and oil pumping problems when the compressor is exposed to low ambient temperatures. It is a 208 volt, 250 watt resistance heater enclosed within tubing. Oil capacity of the compressor is 3½ pints FSN 9150-823-7905. The compressor comes from the manufacturer full of oil.

*b. Removal and Disassembly.* Refer to paragraph 5-30, and remove the compressor. Refer to figure 5-24, and disassemble the heater and oil plug.

*c. Reassembly and Installation.* Replace defective heater and oil plug and install in reverse order of removal as illustrated in figure 5-24. Refer to paragraph 5-30, and install the compressor. Evacuate and charge the refrigerant system (para 5-33).

*Note.* Proper oil level is even with the bottom of the oil plug. Add slowly to bring oil level to normal position. Use oil of specification VV-L-825, Type IV, (FSN 9150-823-7905).

### 5-32. Casing, Base and Duct Assembly

*a. General.* The casing and base support protects the components of the air conditioner. They also provide air control around the components of the unit. A duct assembly permits control of the source of ventilation air. Baffles provide additional automatic air control while the damper is manually adjusted.

*b. Removal.* Refer to figure 5-25 and remove the casing, base and duct assembly.

*c. Installation.* Install casing, base and duct assembly in reverse order of removal as illustrated in figure 5-25.

*d. Inspection.* Inspect the baffle, damper assembly and insulator for signs of wear, breaks, cracks or other damage.

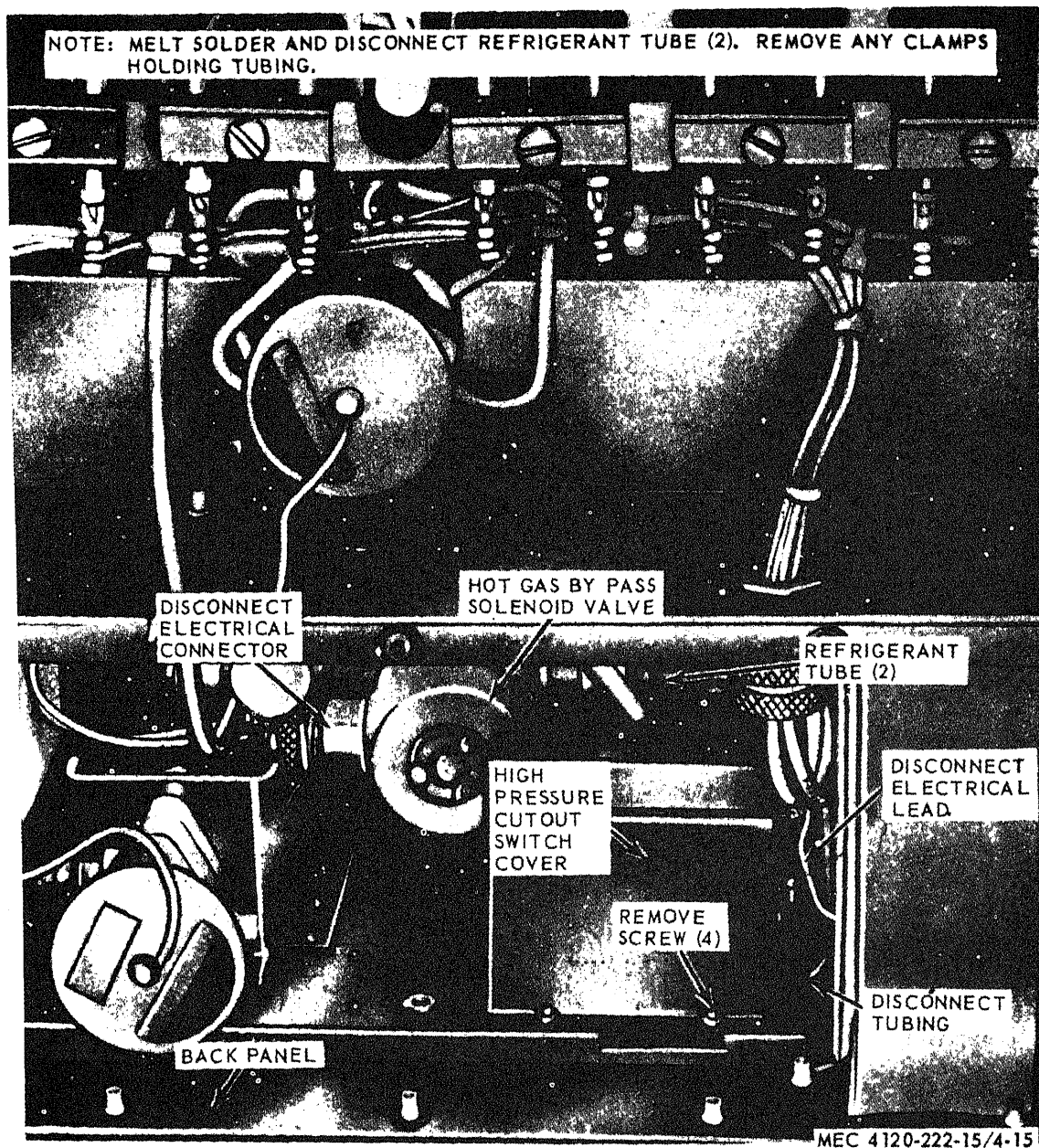


Figure 5-15. Hot gas bypass solenoid valve, and high pressure cutout switch, removal and installation.

### 5-33. Servicing the Refrigerant System

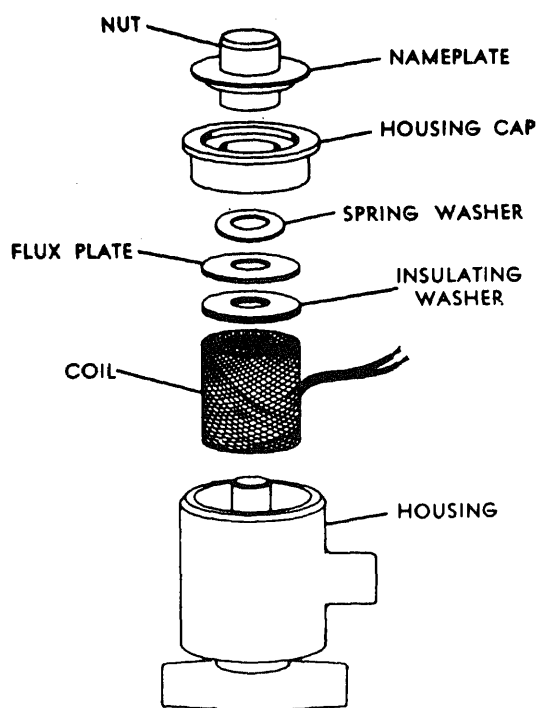
#### a. Testing Refrigerant System for Leaks.

(1) *Electronic or halide torch leak detector.* The preferred method of testing for leaks in the refrigerant system is by using a halide torch. A halide detector is used by passing the exploring tube over sweat fittings, all mechanical couplings, and valves. If refrigerant is leaking from the system, the flame of the halide torch will change from blue to green when the leak is small. If the leak is large, the flame will be dense blue with a

torch. Mark all spots where leaks are noticed. Drain the refrigerant system and repair the leak, and pressure test.

**Warning:** Avoid bodily contact with liquid refrigerant and avoid inhaling refrigerant gas. Be especially careful that refrigerant -22 does not come in contact with the eyes. In case of refrigerant leaks, ventilate the area immediately.

(2) *Soap solution method.* Operate the air conditioner, brush all possible points of leakage with soap solution, and watch for bubbles. Follow



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Figure 5-16. Hot gas bypass solenoid valve, disassembly and reassembly.

tested. Wipe the soap solution from all joints and mark any spot where a leak occurs. Drain the refrigerant system and repair leak and pressure test.

*b. Purging.* Attach a suitable hose to the suction service valve and discharge the refrigerant into a safe area.

*c. Pressure testing and evacuating.* Refer to figure 5-26, and pressure test and evacuate the refrigerant system.

*d. Charging.* Refer to figure 5-27 and 5-28, charge the refrigerant system.

*Note.* Capacity of refrigeration system is 3.7 lb refrigerant -22 FSN 6830-174-9677.

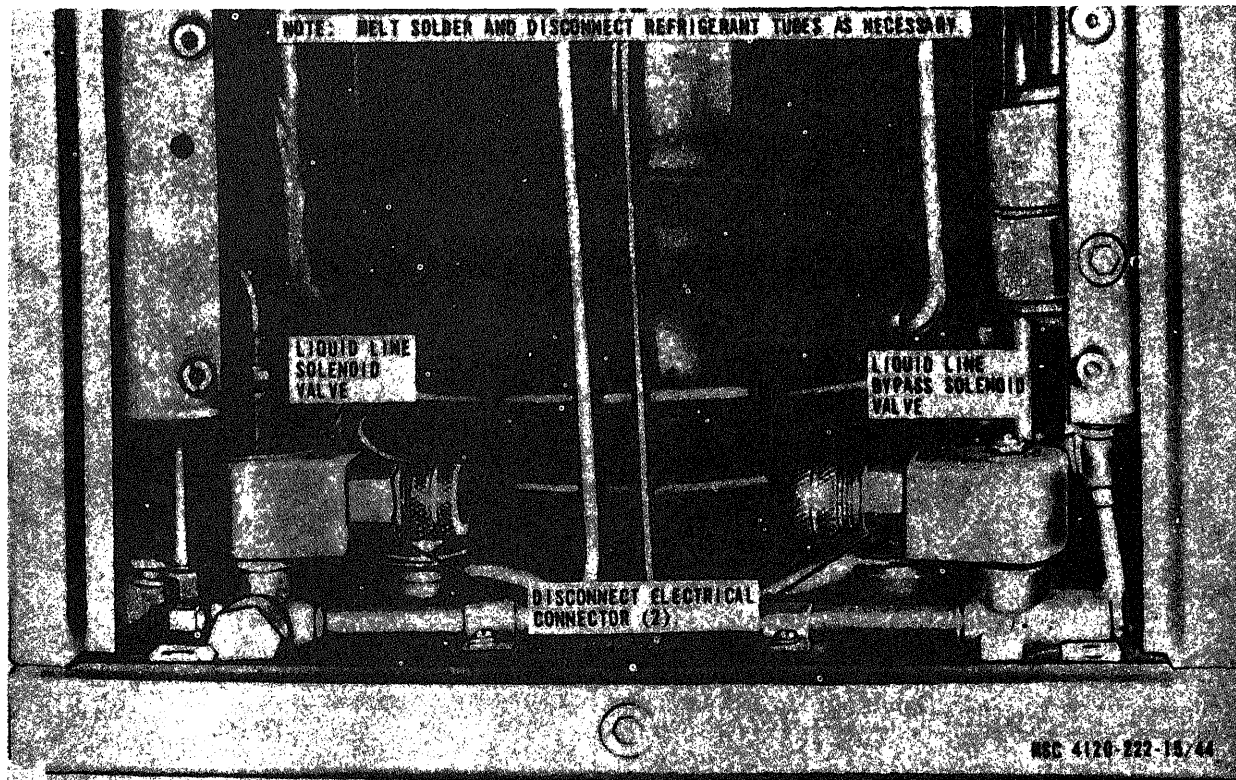
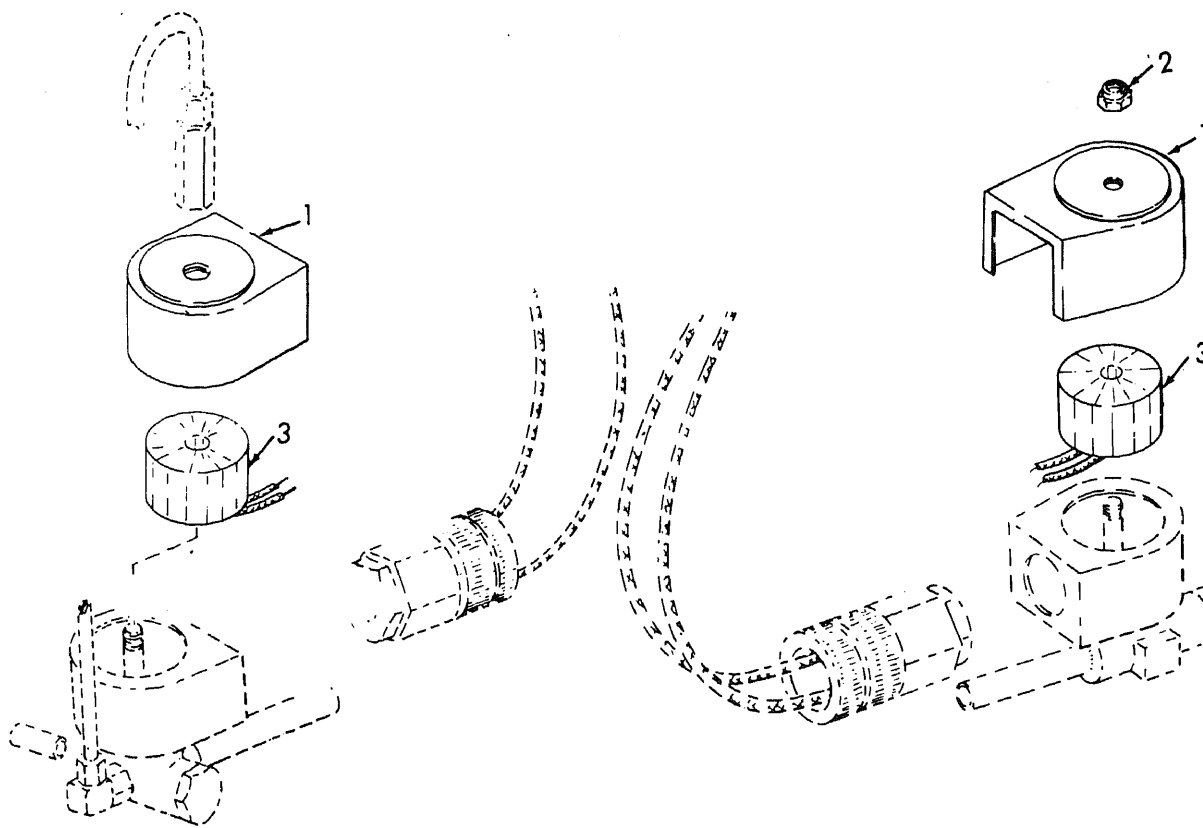


Figure 5-17. Liquid line solenoid valve, removal and installation.



MSC 4120-222-15/4

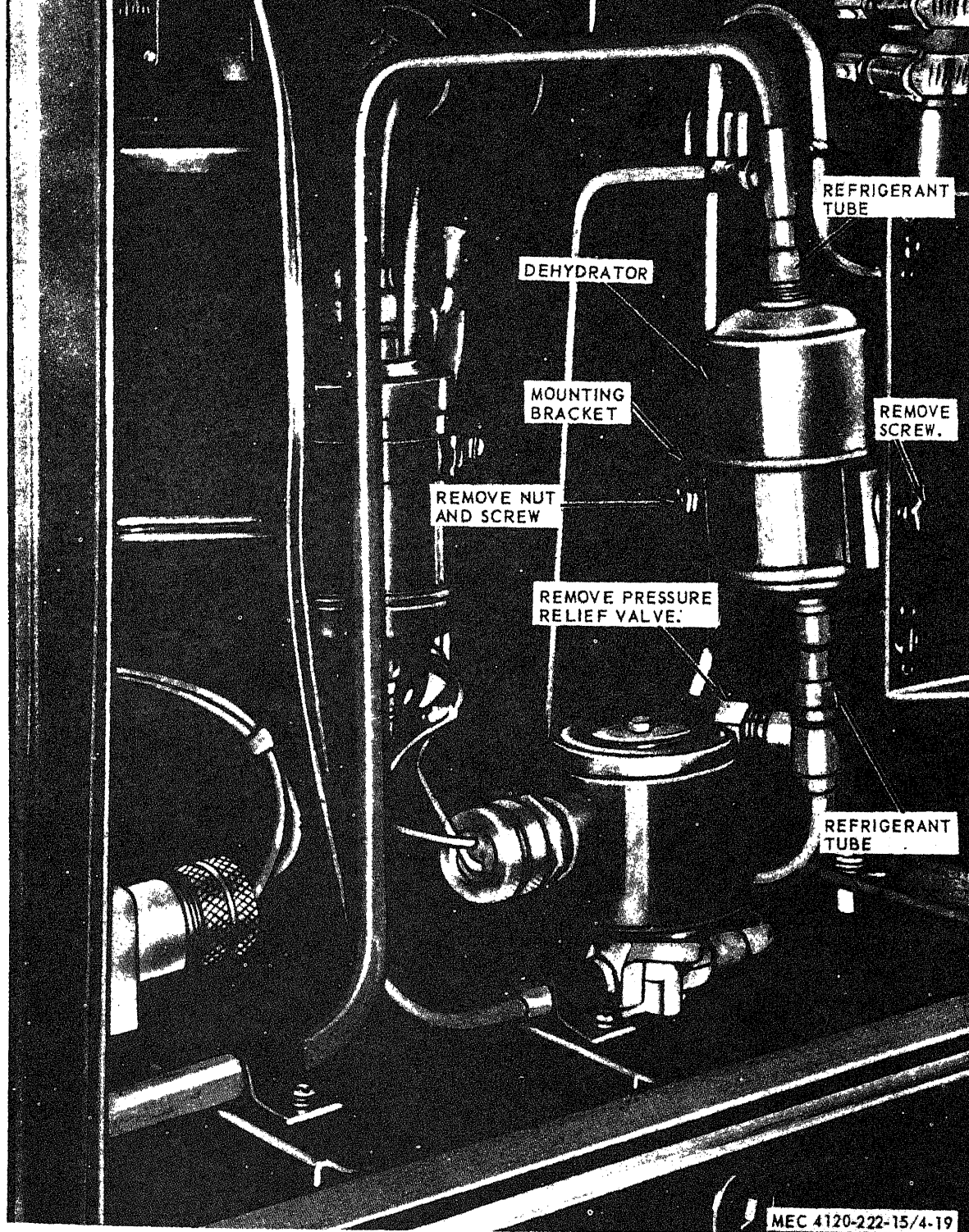
1 Coil cover (2 rqr)

2 Cover retaining nut (spec)

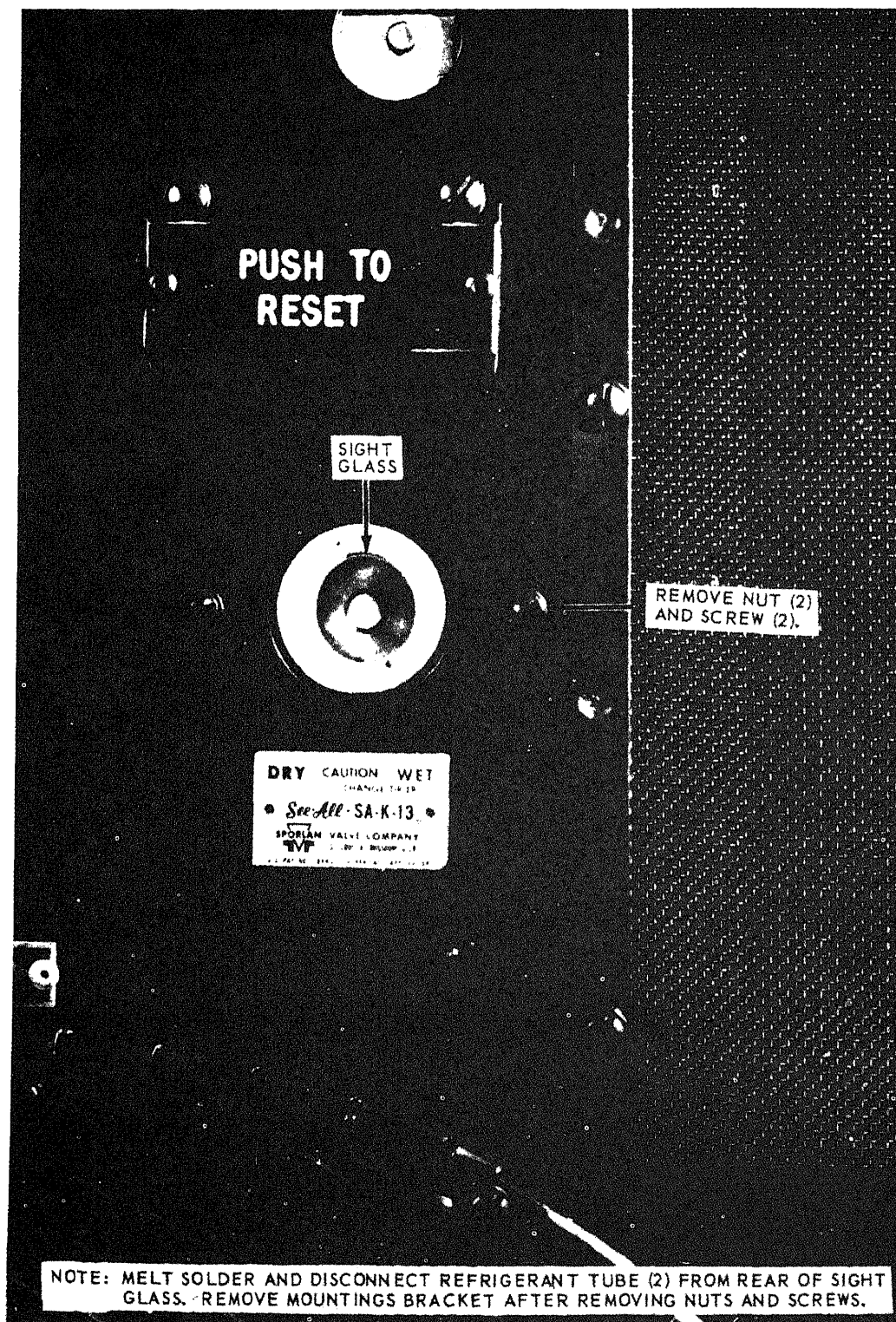
3 Solenoid valve coil (2 rqr)

*Figure 5-18. Liquid line solenoid valve, disassembly and reassembly.*





*Figure 5-19. Dehydrator and pressure relief valve, removal and installation.*



MEC 4120-222-15/4-20

Figure 5-20. Sight glass removal and installation.

NOTE: MELT SOLDER AND DISCONNECT REFRIGERANT TUBES AS NECESSARY.

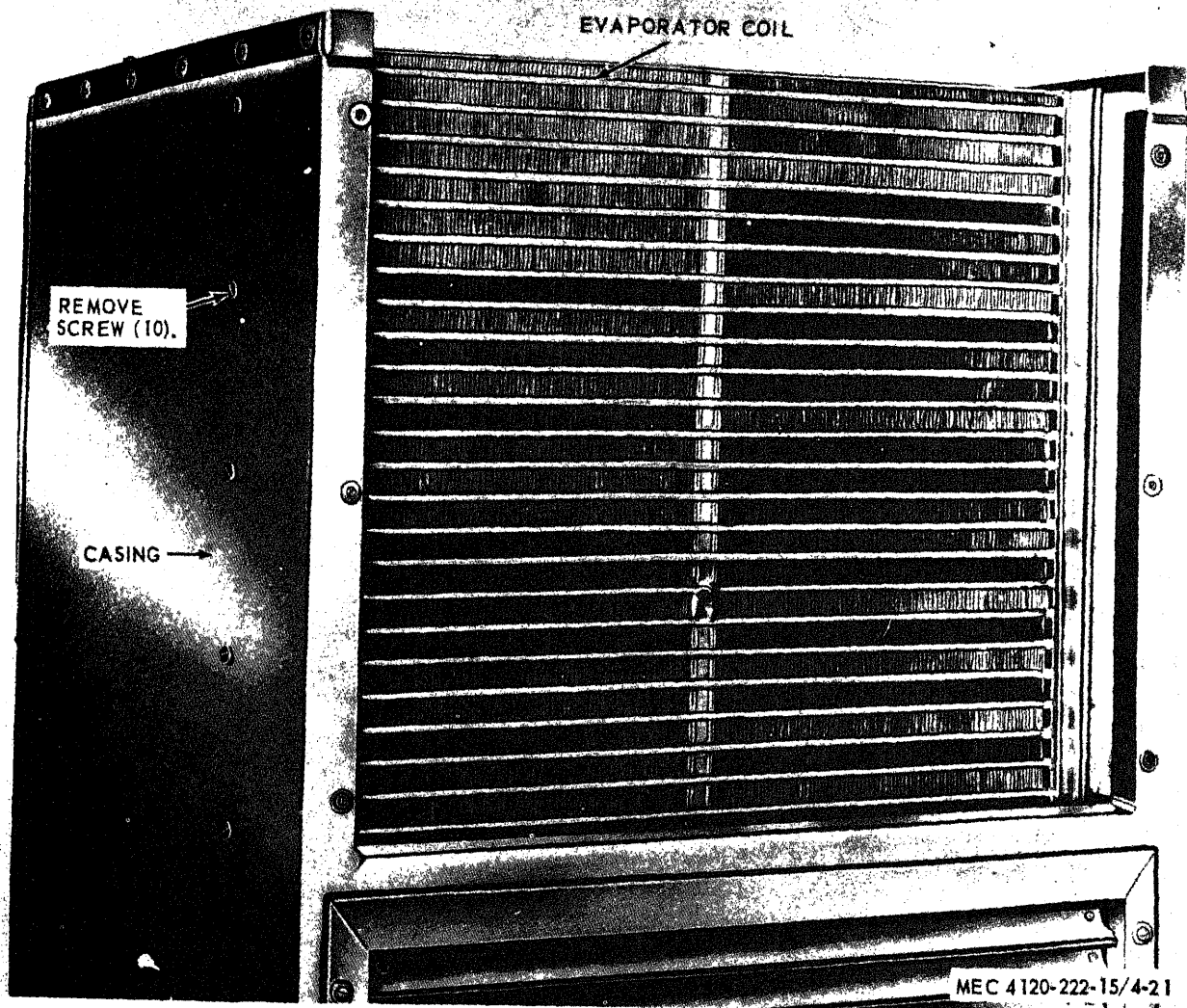
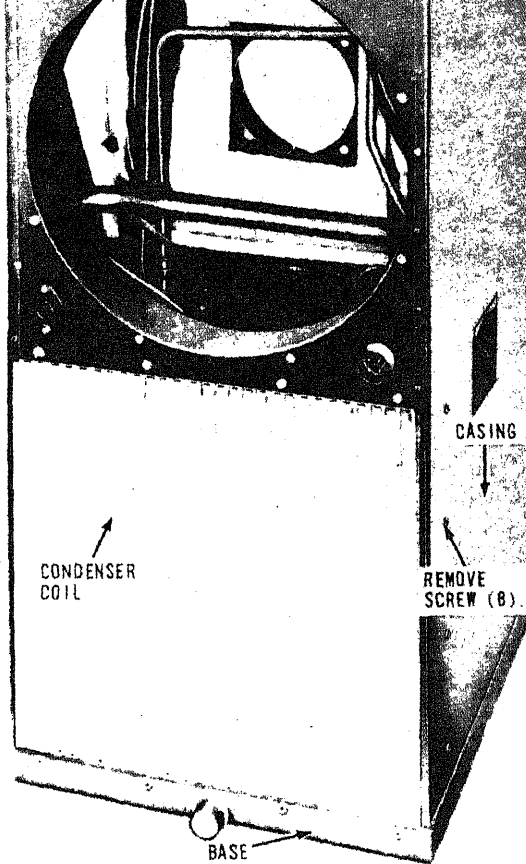


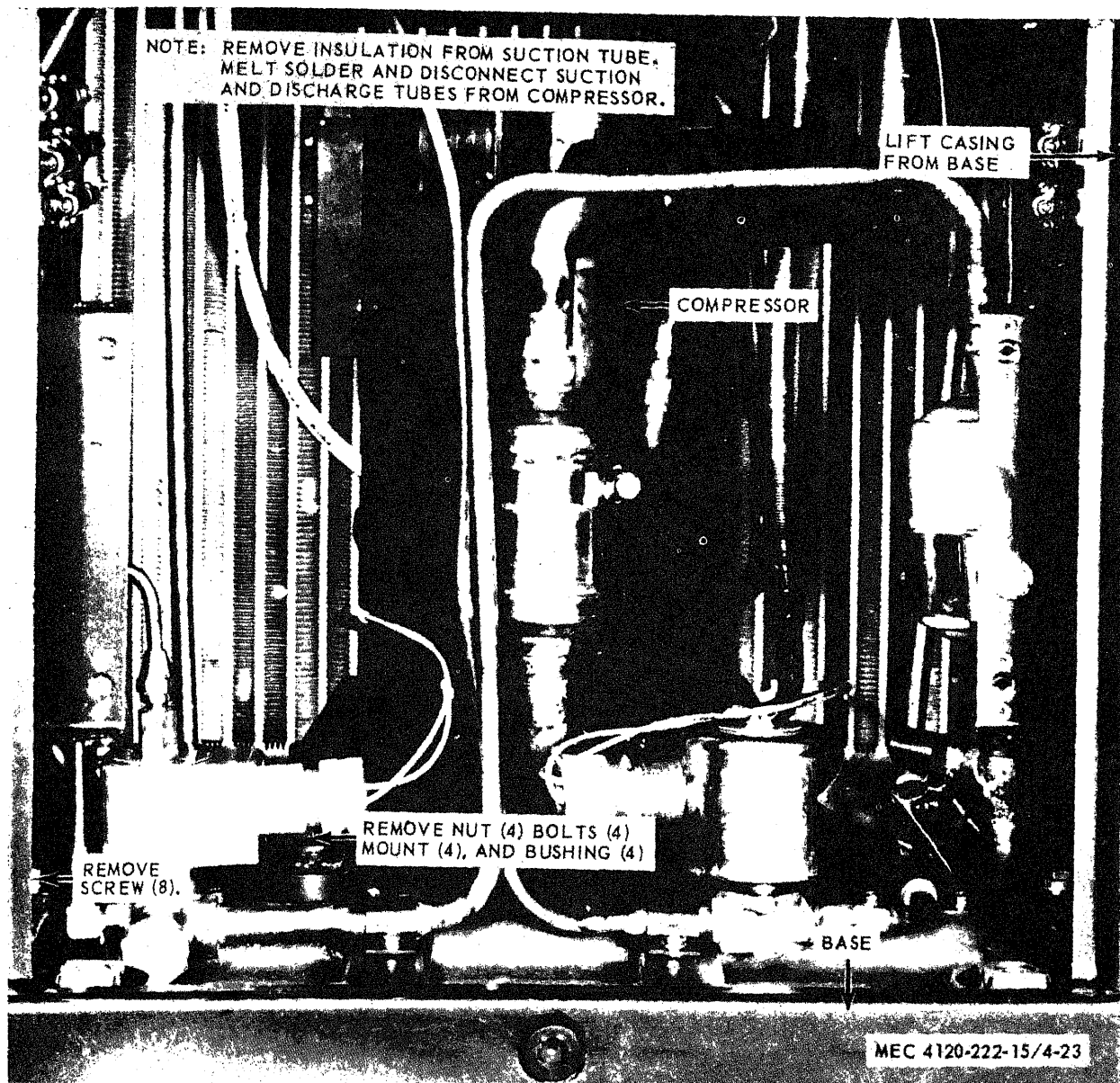
Figure 5-21. Evaporator coil removal and installation.



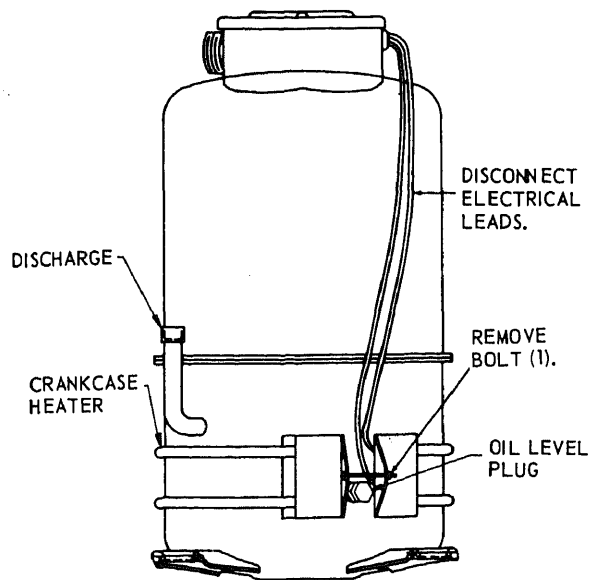


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*Figure 5-22. Condenser coil, removal and installation.*

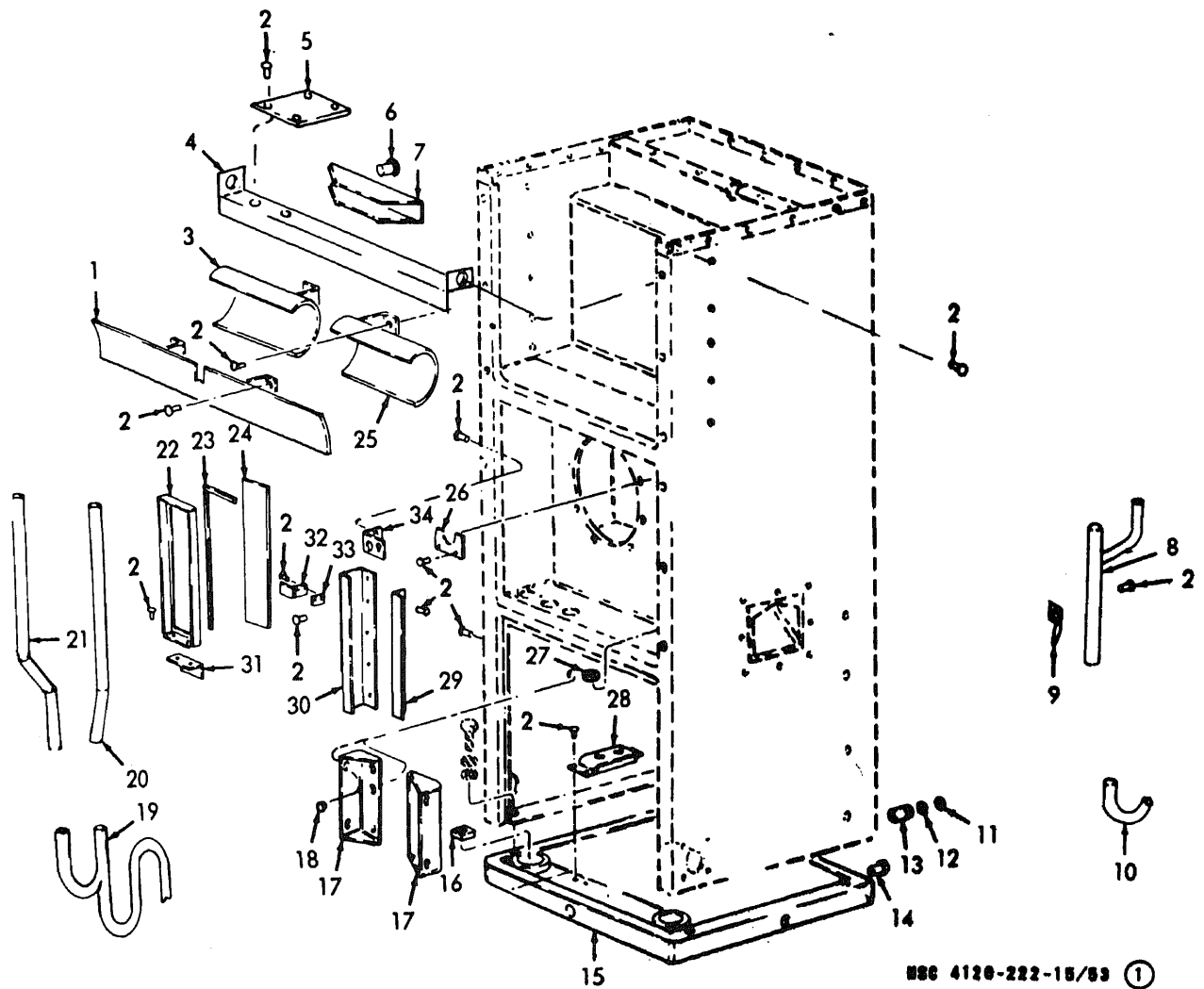


*Figure 5-23. Compressor, removal and installation.*



MEC 4129-222-15/4-24

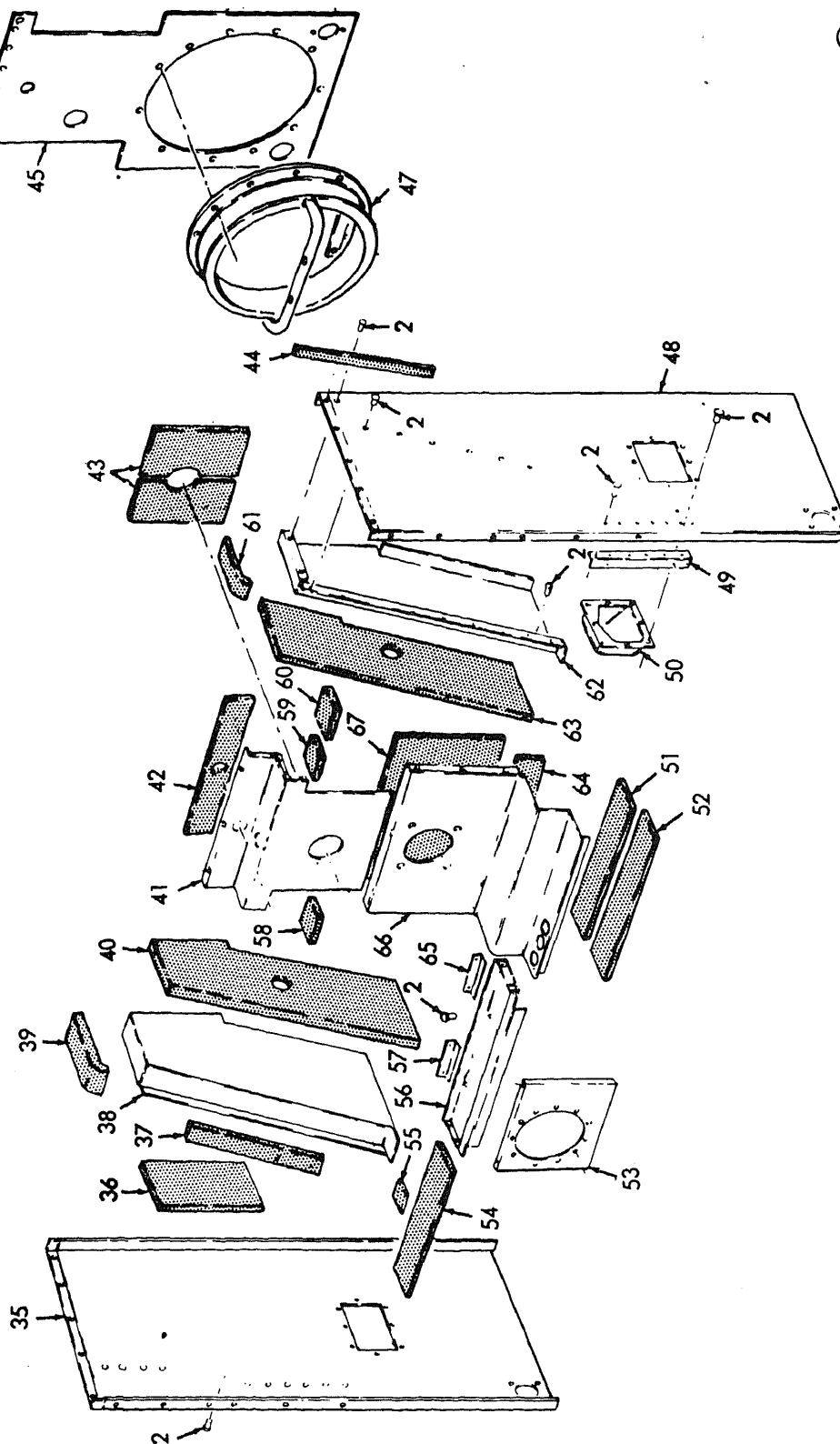
*Figure 5-24. Compressor heater and compressor oil level plug, removal, disassembly and installation.*



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- |  |                                  |                              |
|--|----------------------------------|------------------------------|
| 1 Lower baffle                           | 11 Retainer ring                 | 28 Gasket                    |
| 2 Pop rivet, ½ in. X 0.063 in. (239 rqr) | 12 Drain screen                  | 24 Damper blade              |
| 3 Top left baffle                        | 13 Drain nipple                  | 25 Top right baffle          |
| 4 Evaporator heater support              | 14 Rivet nut, No. 8-32 (4 rqr)   | 26 Blockoff plate            |
| 5 Evaporator heater thermostat bracket   | 15 Base                          | 27 Grommet                   |
| 6 Pop rivet (4 rqr)                      | 16 Nut, square (7/16-14 (4 rqr)) | 28 Support channel (2 rqr)   |
| 7 Back panel support                     | 17 Control box support (2 rqr)   | 29 Filter support            |
| 8 Right drain tube                       | 18 Rivet nut, ¼-20 (4 rqr)       | 30 Filter support            |
| 9 Drain tube clamp (4 rqr)               | 19 Bottom left drain tube        | 31 Blockoff angle            |
| 10 Bottom right drain tube               | 20 Rear left drain tube          | 32 Hinge door spring (2 rqr) |
|  | 21 Front left drain tube         | 33 Shim (4 rqr)              |
|  | 22 Damper door frame             | 34 Chain guide angle         |

Figure 5-25. Casing, base and duct assembly, removal, disassembly, reassembly and installation. (Sheet 1 of 2)



35 Right side panel  
36 Rubber insulation  
37 Rubber insulation  
38 Right hand duct  
39 Rubber insulation  
40 Rubber insulation  
41 Top partition panel  
42 Rubber insulation  
43 Rubber insulation  
44 Rubber insulation  
45 Back panel

46 Rivet nut, 5/16-18  
47 Motor support and cone assembly  
48 Left side panel  
49 Filter support  
50 Handle (2 rqr)  
51 Rubber insulation  
52 Rubber insulation  
53 Intake panel  
54 Rubber insulation  
55 Rubber insulation  
56 Drain pan  
57 Drain pan right hand angle  
58 Rubber insulation  
59 Rubber insulation  
60 Rubber insulation  
61 Rubber insulation  
62 Left hand duct  
63 Rubber insulation  
64 Rubber insulation  
65 Drain pan left hand angle  
66 Partition panel  
67 Rubber insulation

Figure 5-25.—Continued. (Sheet 2 of 2)

### Section III. HOSE CLAMPS, HOSES, TUBE RETAINING STRAPS, PIPE PLUGS, RECEPTACLE HOLE COVERS AND TUBE CLIPS

#### 5-34. General

When refrigerant system is opened for maintenance, all hoses and tubes disconnected should be removed, cleaned, inspected, and reinstalled securely.

#### 5-35. Hose Clamps, Hoses, Tube Retaining Straps, Pipe Plugs, Receptacle Hole Covers and Tube Clip

##### *a. Removal.*

- (1) Remove the front access panel (para 3-17).
- (2) Remove the air conditioning filter (para 3-18).
- (3) Discharge the refrigerant system.
- (4) Remove the hose clamps, hoses, tube retaining straps, pipe plugs, receptacle hole covers

and tube clip by removing standard hardware as required.

##### *b. Cleaning and Inspection.*

(1) Clean all parts with an approved solvent and dry thoroughly.

(2) Inspect hoses for signs of wear. Inspect all parts for cracks, breaks or other defects. Inspect threaded parts for worn or damaged threads.

(3) Replace damaged or defective parts.

*c. Installation.* Install all internal parts by reversing order of removal.

*d. Pressure test system.*

*e. Recharge the system.*

*f. Install panel.*

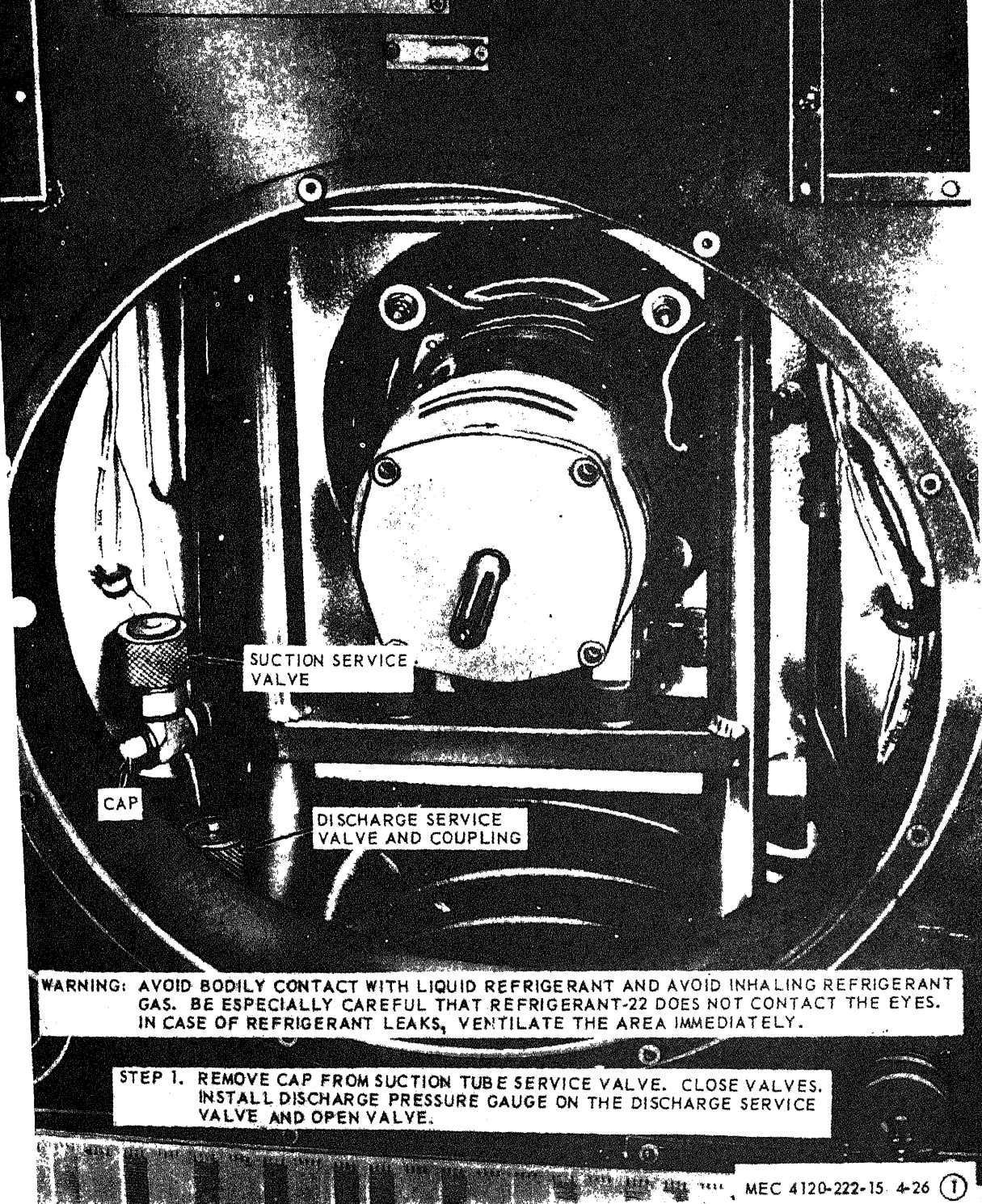
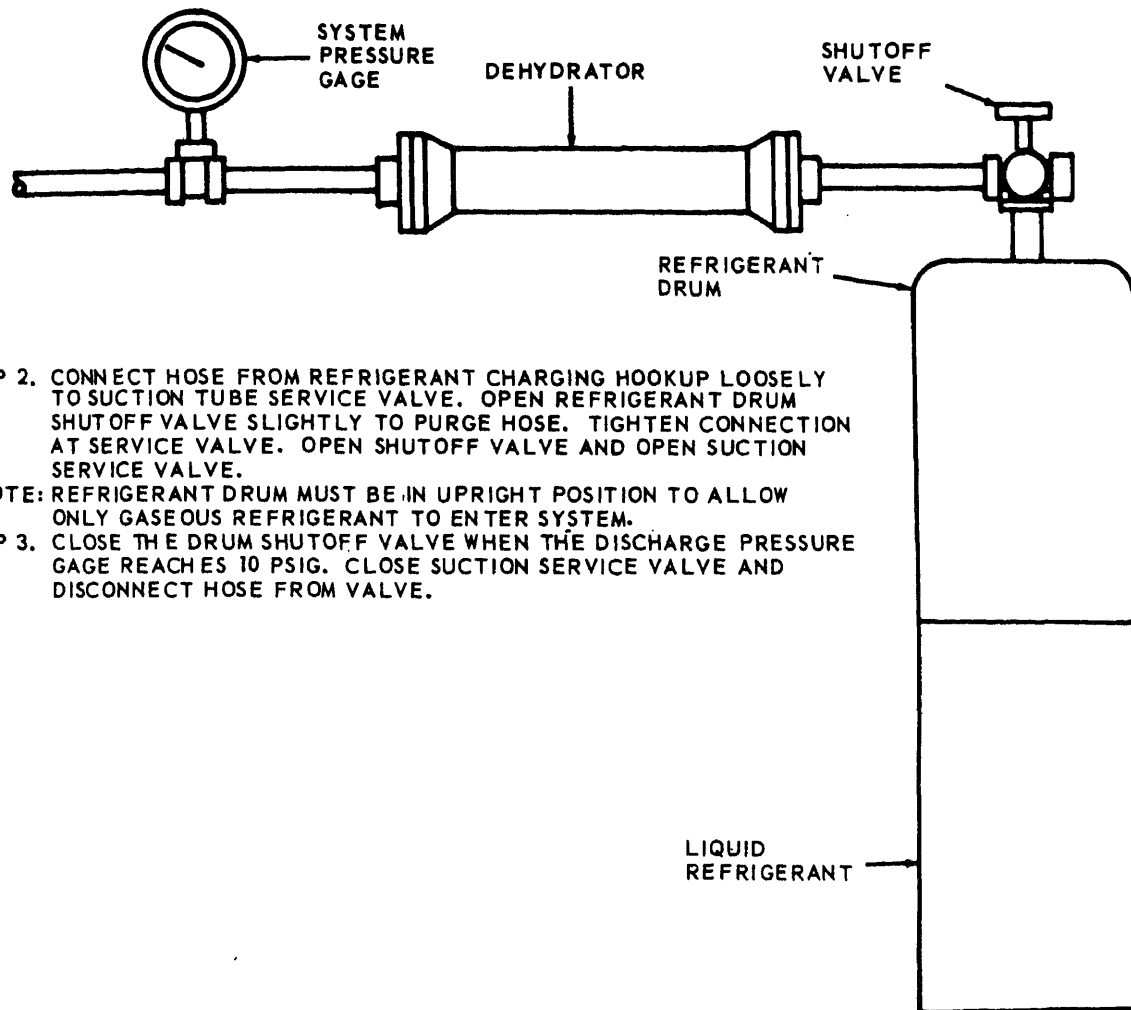


Figure 5-26. Pressure testing and evacuating the refrigerant system. (Sheet 1 of 3)



STEP 2. CONNECT HOSE FROM REFRIGERANT CHARGING HOOKUP LOOSELY TO SUCTION TUBE SERVICE VALVE. OPEN REFRIGERANT DRUM SHUTOFF VALVE SLIGHTLY TO PURGE HOSE. TIGHTEN CONNECTION AT SERVICE VALVE. OPEN SHUTOFF VALVE AND OPEN SUCTION SERVICE VALVE.

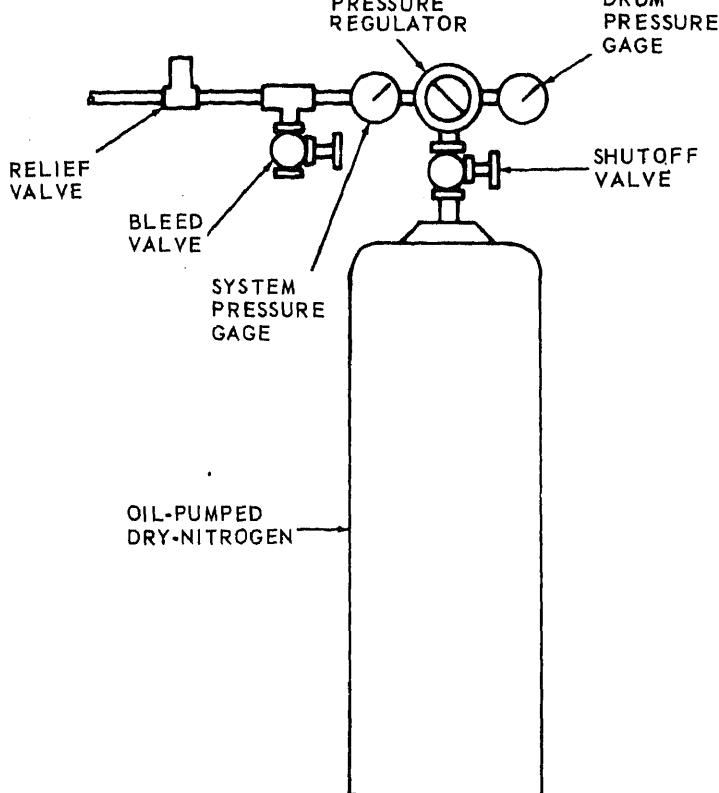
NOTE: REFRIGERANT DRUM MUST BE IN UPRIGHT POSITION TO ALLOW ONLY GASEOUS REFRIGERANT TO ENTER SYSTEM.

STEP 3. CLOSE THE DRUM SHUTOFF VALVE WHEN THE DISCHARGE PRESSURE GAGE REACHES 10 PSIG. CLOSE SUCTION SERVICE VALVE AND DISCONNECT HOSE FROM VALVE.

MEC 4120-222-15/4-26 (2)

Figure 5-26—Continued. (Sheet 2 of 3)





- STEP 4. CONNECT HOSE FROM PRESSURE TESTING HOOKUP LOOSELY TO SUCTION SERVICE VALVE OPEN/NITROGEN DRUM SHUTOFF VALVE SLIGHTLY TO PURGE HOSE. TIGHTEN CONNECTION AT SUCTION SERVICE VALVE. OPEN SHUTOFF VALVE AND SUCTION SERVICE VALVE. BUILD UP SYSTEM PRESSURE UNTIL THE DISCHARGE PRESSURE REACHES 150 PSIG. CLOSE SUCTION SERVICE VALVE AND SHUTOFF VALVE. DISCONNECT HOSE FROM SUCTION SERVICE VALVE. CLOSE DISCHARGE SERVICE VALVE AND REMOVE GAGE.
- STEP 5. TEST FOR LEAKS (2 ABOVE). PURGE THE REFRIGERANT SYSTEM (3 ABOVE).
- STEP 6. REMOVE CAP FROM DISCHARGE SERVICE VALVE. ATTACH A SUITABLE VACUUM PUMP TO SUCTION SERVICE VALVE AND A MANOMETER TO THE DISCHARGE SERVICE VALVE. OPEN THE SERVICE VALVES AND OPERATE THE VACUUM PUMP UNTIL THE MANOMETER INDICATES 2.5 MM HG. ABS. (MILLIMETERS OF MERCURY, ABSOLUTE).
- STEP 7. CLOSE THE SUCTION SERVICE VALVE AND STOP THE PUMP. ATTACH HOSE FROM REFRIGERANT DRUM, PURGE AIR FROM LINE WITH REFRIGERANT AND SLOWLY BREAK THE VACUUM BY OPENING THE SUCTION SERVICE VALVE UNTIL 760 MM HG ABS. CLOSE SUCTION SERVICE VALVE.
- STEP 8. REMOVE REFRIGERANT DRUM AND CONNECT VACUUM PUMP TO SUCTION SERVICE VALVE. PURGE AIR FROM HOSE, START PUMP AND OPEN SUCTION SERVICE VALVE. OPERATE PUMP UNTIL MANOMETER AGAIN READS 2.5 MM HG ABS.
- STEP 9. CLOSE SUCTION SERVICE VALVE AND ALLOW UNIT TO STAND UNDER VACUUM FOR APPROXIMATELY 12 HOURS. IF NO NOTICABLE RISE IN PRESSURE OCCURS, THE SYSTEM IS READY FOR CHARGING. CLOSE SERVICE VALVES AND REMOVE VACUUM PUMP AND MANOMETER. INSTALL CAPS.
- NOTE: RISE IN PRESSURE WILL BE INFLUENCED BY AMBIENT TEMPERATURE. MAKE SURE VACUUM IN SYSTEM IS COMPLETELY RELIEVED BEFORE CHARGING.
- NOTE: THE CONDENSER FAN MOTOR SUPPORT HAS BEEN REDESIGNED ON LATER MODELS. THE BENDIX-WESTINGHOUSE OVERLOAD PROTECTOR AND HEATER THERMOSTAT REMAINS UNCHANGED.

MEC 4120-222-1574-26 ③

Figure 5-26.—Continued. (Sheet 3 of 3)

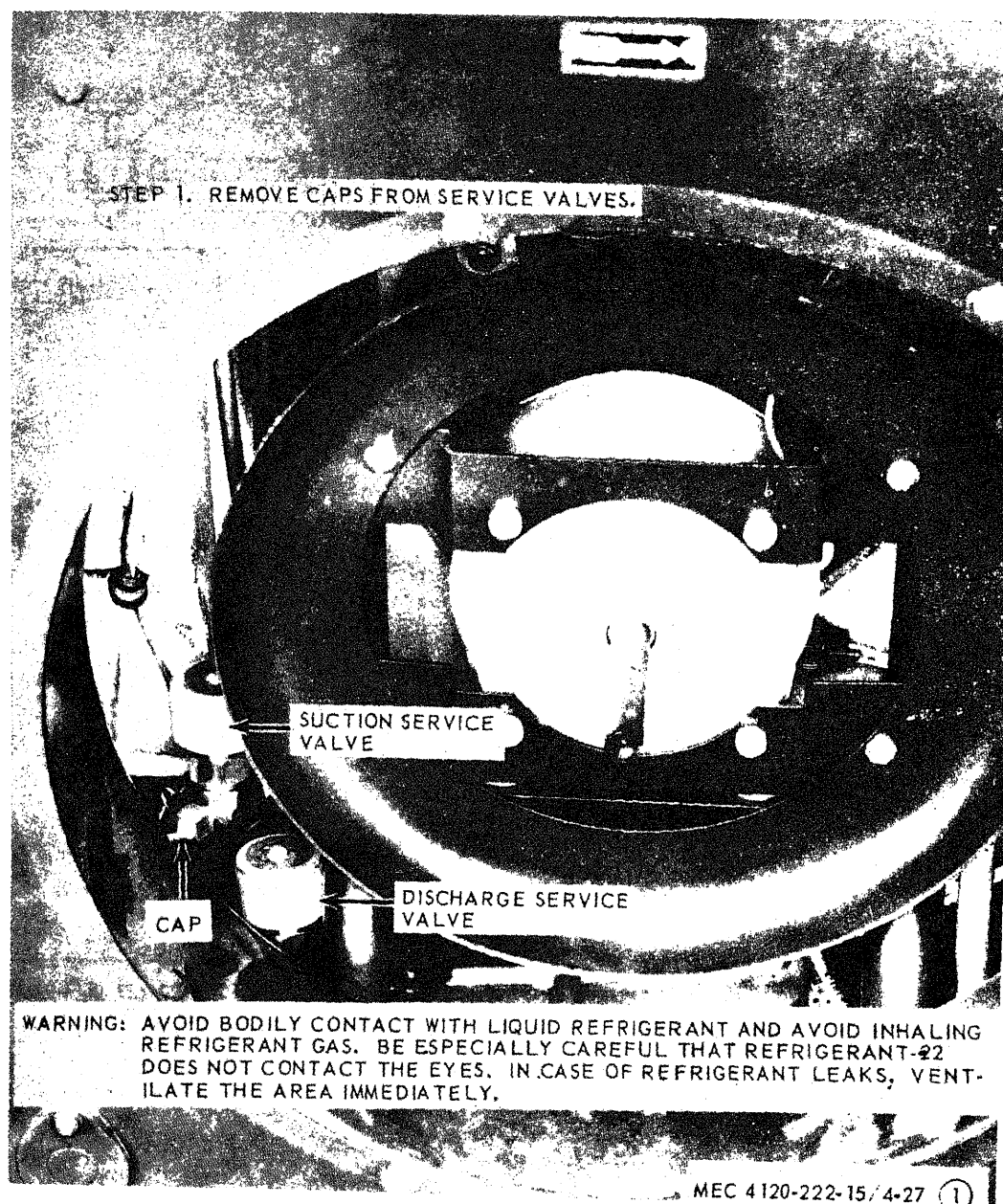
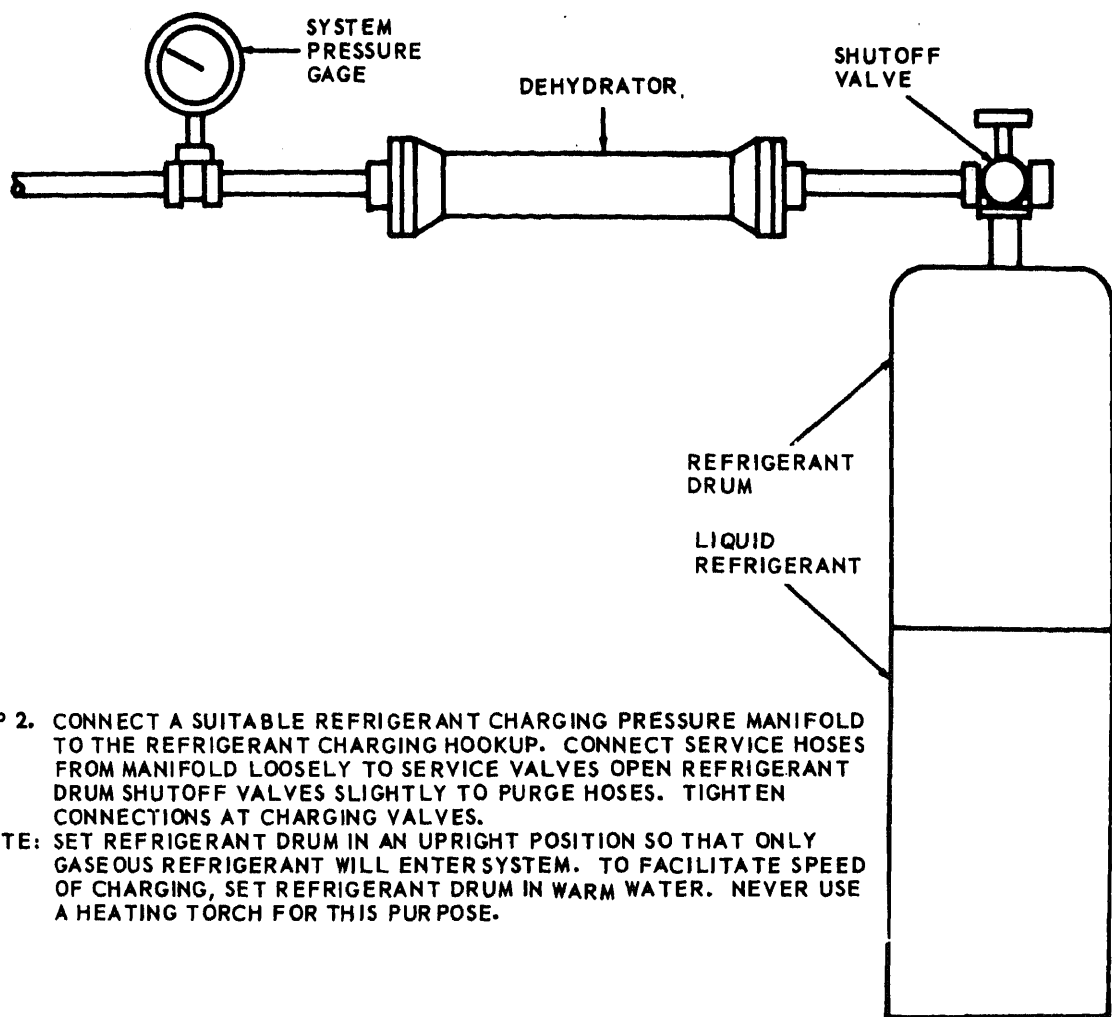


Figure 5-27. Charging the refrigerant system. (Sheet 1 of 3)

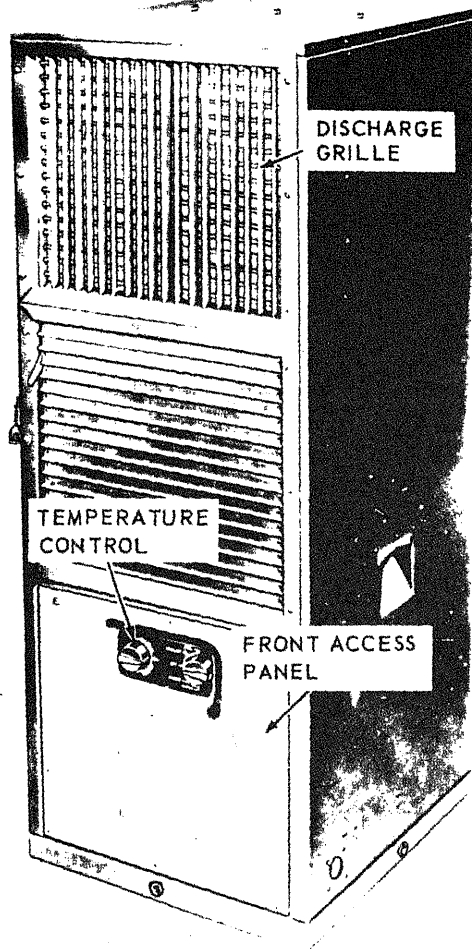


STEP 2. CONNECT A SUITABLE REFRIGERANT CHARGING PRESSURE MANIFOLD TO THE REFRIGERANT CHARGING HOOKUP. CONNECT SERVICE HOSES FROM MANIFOLD LOOSELY TO SERVICE VALVES OPEN REFRIGERANT DRUM SHUTOFF VALVES SLIGHTLY TO PURGE HOSES. TIGHTEN CONNECTIONS AT CHARGING VALVES.

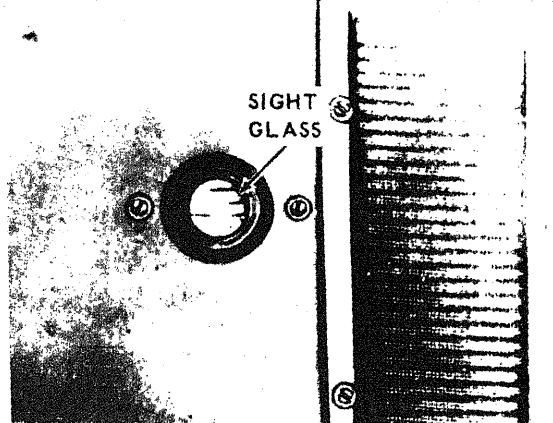
NOTE: SET REFRIGERANT DRUM IN AN UPRIGHT POSITION SO THAT ONLY GASEOUS REFRIGERANT WILL ENTER SYSTEM. TO FACILITATE SPEED OF CHARGING, SET REFRIGERANT DRUM IN WARM WATER. NEVER USE A HEATING TORCH FOR THIS PURPOSE.

MEC 4120-222-15/4-27 (2)

Figure 5-27.—Continued. (Sheet 2 of 3)



NOTE: SET TEMPERATURE CONTROL ABOVE AMBIENT OR ROOM TEMPERATURE.



STEP 3. OPEN REFRIGERANT DRUM SHUTOFF VALVE AND OPEN BOTH SERVICE VALVES. CLOSE HIGH PRESSURE SIDE OF MANIFOLD. OPERATE UNIT (PAR. 2-11) AND WEIGH IN 3.5 LB CHARGE OF REFRIGERANT-22. CONTINUE ADDING REFRIGERANT SLOWLY UNTIL SIGHT GLASS INDICATES FULL.

NOTE: OPERATE UNIT IN COOL POSITION ONLY DURING SERVICING OPERATION.

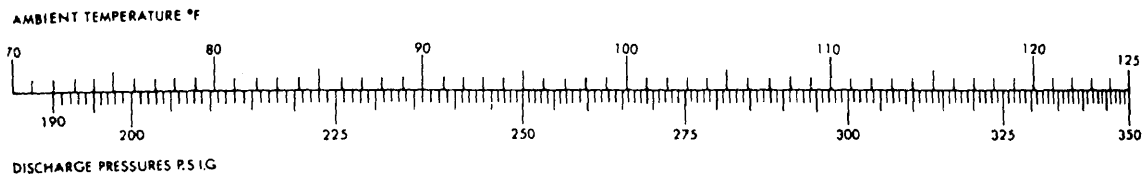
STEP 4. PARTIALLY BLOCK DISCHARGE GRILLE WITH A CARDBOARD BAFFLE. ADJUST BAFFLE UNTIL SUCTION PRESSURE GAGE READS 55 PSIG. CONTINUE ADDING REFRIGERANT SLOWLY, WHILE MAINTAINING 55 PSIG SUCTION PRESSURE BY ADJUSTING THE BAFFLE, UNTIL THE DISCHARGE PRESSURE GAGE READING CORRESPONDS TO THE AMBIENT TEMPERATURE IS OBTAINED.

STEP 5. CLOSE SERVICE VALVES AND CLOSE REFRIGERANT DRUM SHUTOFF VALVE. STOP THE UNIT (PAR. 2-10). DISCONNECT MANIFOLD HOSES FROM SERVICE VALVES. INSTALL CAPS (STEP 1).

ME 4120-222-14/5-27 (3)

Figure 5-27—Continued. (Sheet 3 of 3)

DISCHARGE PRESSURES  
AT CONSTANT 55# PSIG SUCTION  
AMBIENT FROM 70° F. TO 125° F.



MEC 4120-222-15/4-28

Figure 5-28. Discharge pressures at constant 55 lb psi suction, ambient temperatures from 70° F. to 120° F.

## CHAPTER 6

# ADMINISTRATIVE STORAGE AND INSTRUCTIONS FOR DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

### Section I. ADMINISTRATIVE STORAGE

Refer to TM 740-90-1 for instructions on the administrative storage of air conditioner.

### Section II. DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

#### 6-1. General

When capture or abandonment of the air conditioner is imminent, the responsible unit commander must make the decision to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all air conditioners and all corresponding repair parts.

#### 6-2. Demolition by Mechanical Means

To render the air conditioner inoperative by mechanical means, use sledge hammers, crowbars, picks, axes, or other heavy tools which are available to destroy the following:

- a. Compressor and compressor motor.
- b. Condenser assembly (including condenser fan motor).
- c. Evaporator assembly.
- d. Temperature control box and circuit breaker.

#### 6-3. Demolition by Explosives or Weapons Fire

a. *Explosives.* Place as many charges as the situation permits, and detonate them simultaneously with a detonating cord and suitable detonator. Position charges as follows:

- (1) One ½ pound charge inside the circuit breaker panel.
- (2) One ½ pound charge on the condenser fan.
- (3) One ½ pound charge on the compressor.

(4) One ½ pound charge on the evaporator assembly.

b. *Weapons Fire.* Fire on the air conditioner using the heaviest practicable weapons available.

#### 6-4. Other Demolition Methods

a. *Scattering and Concealment.* Remove all easily accessible parts and scatter them through dense foliage, bury them or throw them in a body of water.

b. *Burning.* Pack rags, clothing, or canvas under and around the unit and inside the condenser and evaporator frames. Saturate this packing with gasoline, oil, or diesel fuel and ignite.

c. *Submersion.* Completely submerge the unit in a body of water to provide water damage and concealment. Salt water does greater damage to metal parts than fresh water.

#### 6-5. Training

All operators should receive thorough training in the destruction of the equipment. Refer to FM 5-25. Simulated destruction using all methods listed should be included in the operator training program. It must be emphasized, in training, that demolition operations are usually necessitated by critical situations when time available for carrying out destruction are limited. For this reason, operators must be thoroughly familiar with all methods of destruction of equipment, and must be able to carry out demolition instructions without reference to this or any other manual.

## **APPENDIX A**

### **REFERENCES**

---

#### **A-1. PAINTING**

TM 9-213                      Painting Instructions for Field Use.

#### **A-2. MAINTENANCE**

TM 38-750                      Army Equipment Record Procedures.

TM 5-4120-222-24P              Organizational, Direct and General Support Repair Parts and Special Tool  
   Lists.

TM 5-764                      Electric Motor and Generator Repair.

#### **A-3. SHIPMENT AND STORAGE**

TM 740-90-1                      Administrative Storage of Equipment.





## APPENDIX B

### BASIC ISSUE ITEMS LIST

#### Section I. INTRODUCTION

##### B-1. Scope

This appendix lists items which accompany the Air Conditioner or are required for installation, operation, or operator's maintenance.

##### B-2. General

This Basic Issue Items List is divided into the following sections:

*a. Basic Issue Items—Section II.* A list of items which accompany the Air Conditioner and are required by the operator/crew for installation, operation, or maintenance.

*b. Maintenance and Operating Supplies—Section III.* NOT APPLICABLE.

##### B-3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, Section II.

*a. Source, Maintenance, and Recoverability Codes (SMR).*

(1) Source code, indicates the selection status and source for the listed item. Source code is:

Code	Explanation
P	Repair parts which are stocked in or supplied from the GSA/DSA or Army supply system and authorized for use at indicated maintenance categories.

(2) Maintenance code, indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	Explanation
C	Operator/crew

(3) Recoverability code, indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable.

*b. Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description.* This column indicates the Federal item name and any additional description of the item required.

*d. Unit of Measure (U/M).* A 2 character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

*e. Quantity Incorporated in Unit.* This column indicates the quantity of the item used in the assembly group.

*f. Quantity Furnished With Equipment.* This column indicates the quantity of an item furnished with the equipment.

*g. Illustration.* This column is divided as follows:

(1) *Figure Number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item Number.* Indicates the callout number used to reference the item in the illustration.

#### Section II. BASIC ISSUE ITEMS

(1) Smr Code	(2) Federal stock No.	(3) Description		(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration	
		Ref No. & Mfr Code	Usable on code				(A) Fig No.	(B) Item No.
PG	7510-889-3494	BINDER, Looseleaf		ea		1		
PC	7520-559-6918	CASE, Maintenance and Operation Manuals ARMY TECHNICAL MANUAL TM 5-4120-222-14				1		
						1		

(1) Smr Code	(2) Federal stock No.	(3) Description		(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration	
		Ref No. & Mfr Code	Usable on code				(A) Fig No.	(B) Item No.
PC	5935-846-2328	ATTENUATOR (97403)	13215E9885	ea		1		
PC		BLOCKOFF PANEL (97403)	13215E9885	ea		1		
PC		RECEPTACLE, Electrical (96906)	MS3106R22-22-S	ea		1		

## APPENDIX C

### MAINTENANCE ALLOCATION CHART

#### Section I. INTRODUCTION

##### C-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

##### C-2. Explanation of Columns in Section II

a. *Group Number. Column 1.* The assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.

b. *Assembly Group. Column 2.* This column contains a brief description of the components of each assembly group.

c. *Maintenance Functions. Column 3.* This column lists the various maintenance functions (A through K) and indicates the lowest maintenance level authorized to perform these functions. The symbol designations for the various maintenance levels are as follows:

- C—Operator or crew
- O—Organizational maintenance
- F—Direct support maintenance
- H—General support maintenance

The maintenance functions are defined as follows:

A—*Inspect.* To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B—*Test.* To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C—*Service.* To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.

D—*Adjust.* To rectify to the extent necessary to bring into proper operating range.

E—*Align.* To adjust specified variable elements of an item to bring to optimum performance.

F—*Calibrate.* To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G—*Install.* To set up for use in an operational environment such as an emplacement, site, or vehicle.

H—*Replace.* To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

I—*Repair.* To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

J—*Overhaul.* To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.

**K—Rebuild.** To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent re-assembly of the item.

**d. Tools and Equipment. Column 4.** This column is provided for referencing by code the special tools and test equipment, (Section III) required to perform the maintenance functions (Section II).

**e. Remarks. Column 5.** This column is provided for referencing by code the remarks (Section IV) pertinent to the maintenance functions.

### C-3. Explanation of Columns in Section III

**a. Reference Code.** This column consists of a number and a letter separated by a dash. The number references the T&TE requirements

column on the MAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC.

**b. Maintenance Category.** This column shows the lowest level of Maintenance authorized to use the special tool or test equipment.

**c. Nomenclature.** This column lists the name or identification of the tool or test equipment.

**d. Tool Number.** This column lists the manufacturer's code and part number, or Federal Stock Number of tools and test equipment.

### C-4. Explanation of Columns in Section IV

**a. Reference Code.** This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

**b. Remarks.** This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, Section II.

## Section II. MAINTENANCE ALLOCATION CHART

AIR CONDITIONER TRANE MODEL CE20VAL4 AND MODEL CE20VAL6

(1) Group No.	(2) Assembly group	(3) Maintenance Functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	FRAME													
	Base assembly.....	H							H					
	Casing assembly.....	H							H					
	Guard, condenser fan.....	O							O					
	Screen, drain.....	O							O					
02	PANELS													
	Baffle.....	H							H					
	Chain and damper control.....	O							O					
	Cover assemblies.....	O							O					
	Damper assembly.....	H							H					
	Grilles.....	O							O					
	Insulation.....	H							H					
	Sound attenuator.....	O							O					
03	ACCESSORY ITEMS													If required
	Remote control.....	O							O					
04	ELECTRIC MOTOR													
	Motor assembly, blower.....		F						O	F				
	Rotor, blower motor.....	F							F					
	Stator, blower motor.....	F							F					
	Cover, stator housing.....	F							F					
	Endbell, housing.....	F							F					
	Housing, stator.....	F							F					
	Bearings.....	F							F					

**AIR CONDITIONER TRANE MODEL CE20VAL4 AND MODEL CE20VAL6—Continued**

(1) Group No.	(2) Assembly group	(3) Maintenance Functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
05	<b>STARTING AND PROTECTING DEVICES.</b>													
	Overload protector.....		F						F					
	Fuse.....		C						C					
	Phase relay.....		F						F					
	Control box.....	F							F					
	Connector, receptacle.....	F							F					
	Control panel assembly.....								F	F				
	Electrical leads.....	O							O					
	Receptacle.....	F							F					
	Circuit breaker.....		F						F					
	Switch, pressure.....		F						F					
	Thermostats.....		F						F					
06	<b>ELECTRICAL EQUIPMENT</b>													
	Heater elements.....	F							F					
	Rectifier.....		F						F					
07	<b>GAGES</b>													
	Sight glass.....	O							H					
08	<b>REFRIGERATION AND AIR CONDITIONING COMPONENTS.</b>													
	Compressor assembly.....		H	H					H					A
	Tubing and fittings.....	H	H						H					
	Valve, regulating.....				F				F					
	Valve, service.....								F					
	Valve, pressure relief.....								F					
	Valves, solenoid.....		F						F	F				
	Condenser assembly.....			C						H				B
	Dehydrator.....								F					
	Evaporator assembly.....	O		C					F	F				C
	Mist eliminator.....			C					O					
	Expansion valve.....				F				H					
	Fan assemblies.....								O					
	Air filters.....			C					O					D

**Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS**

Reference code	Maintenance level	Nomenclature	Tool No.
No special tools or test equipment required to perform maintenance on the air conditioner.			

**Section IV. REMARKS**

Reference code	Remarks
A-C	Service includes check of oil level and add oil using clean, fresh, dry oil of Specification (FSN 9150-823-7905).
A-B	Testing includes the use of the Halide Torch Leak Detector, or a soap solution to detect leaks.
B-C	Clean with approved solvent, dry thoroughly.
C-C	Clean with approved solvent, dry thoroughly.
D-C	Clean with approved solvent, dry thoroughly, and recoat with oil or filter-coat.



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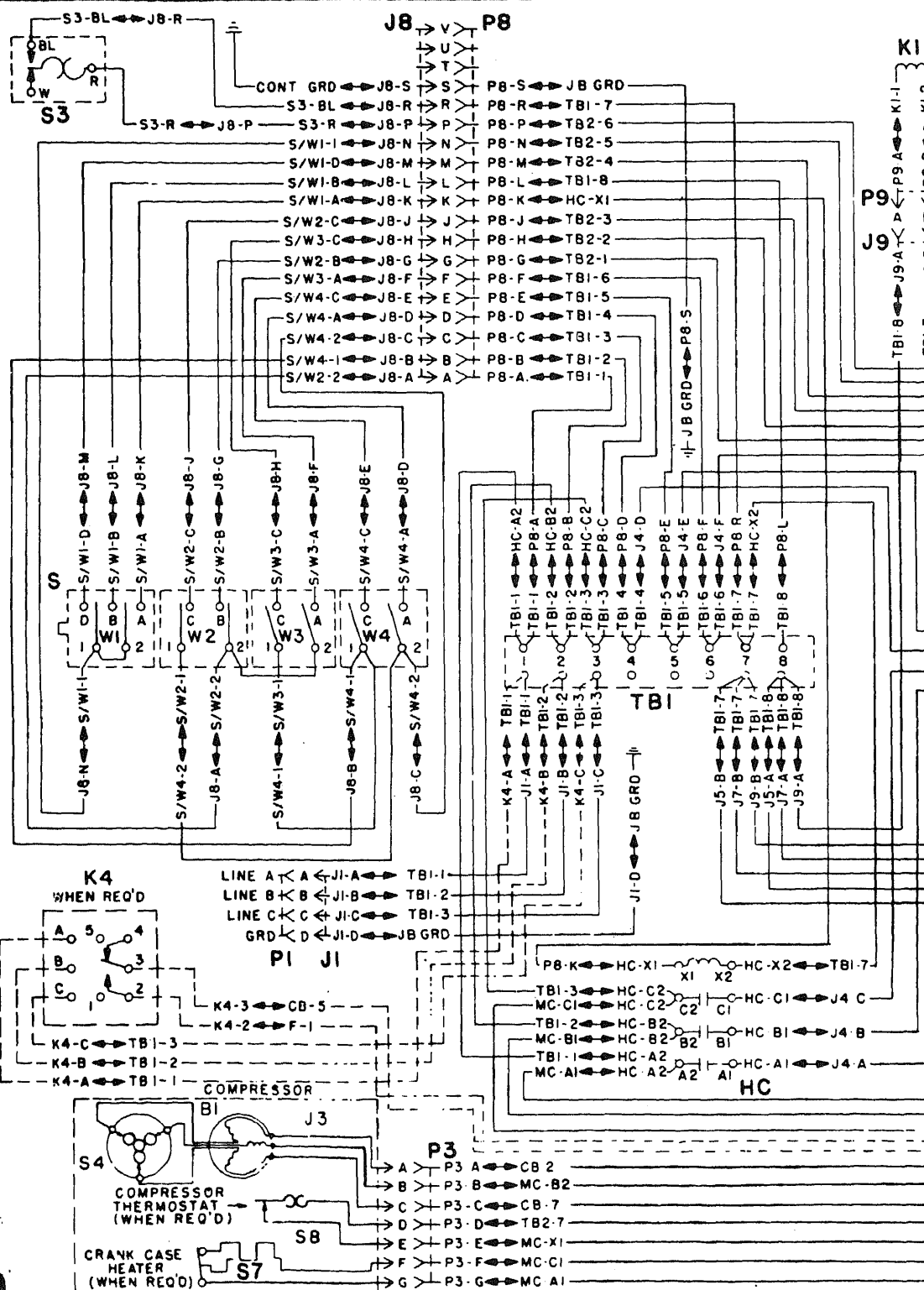
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